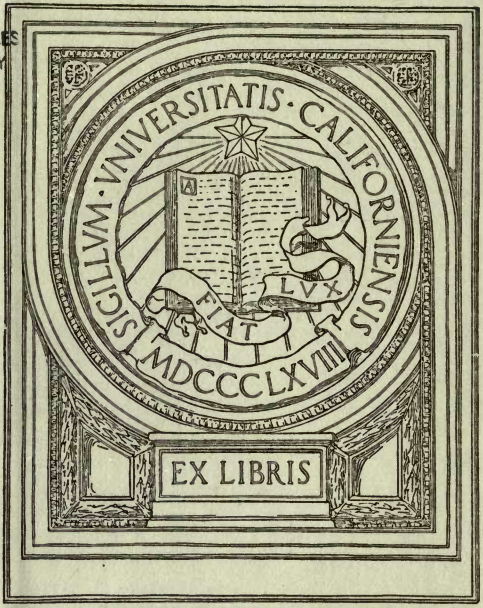
BERKELEY
LIBRARY
UNIVERSITY OF
CALIFORNIA

EARTH
SCIENCES
LIBRARY



Presented by
F. P. Brewer.

Presented by
J. J. Stone.

TREATISE

ON

MINERALOGY.

BY

CHARLES UPHAM SHEPARD, A. B.

Lecturer on Botany in Yale College; Member of the American Geological Society; Corresponding Member of the Academy of Natural Sciences of Philadelphia, of the Natural History Society of Montreal, and of the French Society of Universal Statistics, &c.

NEW HAVEN:

HEZEKIAH HOWE.

1832.

S5

EARTH
SCIENCES
LIBRARY

Entered according to the Act of Congress, in the year 1832, by CHARLES U. SHEPARD, in the Clerk's office, of the District Court of Connecticut.

38718

Printed by Hezekiah Howe.

PREFACE.

The leading features of the present treatise are due to the circumstances under which the author studied Mineralogy. Situated out of the reach of personal instruction, or the facilities which a well arranged collection affords, he was compelled to acquire his knowledge of Terminology from the descriptions of species contained in various works upon the science, with the aid of such a collection of minerals as the vicinity in which he lived principally afforded. The problem of determining from books the names of his minerals was frequently to be solved; and he soon discovered how little benefit he could enjoy in the task, from the scientific process by which the Botanist and Zoologist are guided to the names of objects in their respective departments. A complete treatise was often to be perused—species after species in succession, from beginning to end—in order to arrive at the name of a particular mineral. A method of proceeding like this, however annoying it might occasionally prove to the student accustomed to the simple and precise systems of Natural History, could nevertheless, from the limited number of species in Mineralogy, have been tolerated, but for the painful uncertainty in which it often left the mind when every species had been examined, and some one fixed upon perhaps, as that to which the individual under examination might belong. This want of confidence, however, which he was continually prevented from placing in the accuracy of his results, made all his early studies of a nature most discouraging. Nor was it

always possible to derive the satisfaction desired, from others. Doubtful minerals would come back referred to two or three species, or with a name followed by that modest sign of ignorance—the well known interrogation point. Or if correctly referred, the descriptions of the author would not in all cases coincide with the *ipse dixit* of the umpire, and therefore left no certain verification in the case. Thus, the determination of minerals was found to be not only empirical, but often impracticable.

The cause of this was sufficiently obvious. The classes and subordinate divisions were founded upon such properties as prevented them from being available to the mineralogist,—requiring the practice of a difficult department of another science; so that no one thought of employing them in reducing a mineral to its place in the system. No scientific process existed for leading the inquirer to the name of an unknown mineral; but it was left to the general descriptions to perform a task to which, from the nature of the case, they were incompetent. Indeed, it appears to have been taken for granted by the authors of the mineralogical treatises of that period, that students were in all cases to acquire a knowledge of Mineralogy through teachers and cabinets; and that if, after being thus taught, it should ever become necessary to determine a mineral, it must be taken for that purpose to some professor of the science.

That the determinative part of Mineralogy was suffered to remain so long in this condition, can only be explained by the fact, that the study was chiefly cultivated by Chemists; who, not having experienced the advantages of the methods of Natural History, were in a measure unconscious of the embarrassments under which they labored.

The first classification available for this purpose which the author met with, was that of Mr. H. J. Brooke, at the end of his *"familiar introduction to Crystallography;"** where crystallized minerals are distributed into orders according to their primary forms. By this scientific method he was often aided in the recognition of minerals; and so well convinced was he of its judiciousness, that he has adopted it, as will be seen, for the grounds of his orders in two of the classes in the Analytical System advanced in this work.

In the year 1826, the truly admirable treatise of Prof. Mohs was made known to the American public through the translation of Mr. Haidinger.† This work immediately caught the attention of the author, and realized in the most perfect manner all he had wished for respecting the developement of the different departments of Mineralogy. Not only the distinctions required for the determination of minerals, but a new arrangement indicating more exactly their natural affinities, and a nomenclature expressive of such relations, were all accomplished.

While, however, the treatise in question seemed to have settled Mineralogy in all its great points, and to have conferred upon it the true marks of a science,—advancing it to its proper place among the Natural Sciences; still, the abstruse manner in which that part of Terminology was treated which relates to Crystallography, (involving as it did a familiarity with the higher branches of the mathematics,) and the application of his Characteristic to the Synthetical

* A Familiar Introduction to Crystallography. By Henry James Brooke. 8vo. London: 1823.

† Treatise on Mineralogy, by Frederick Mohs; translated from the German, by William Haidinger. 3 vols. 8vo, Edinburgh: 1825.

Arrangement, precluded at once its use among the majority of those who wish to acquire some knowledge of the mineral kingdom.

Under these circumstances, the author imagined that he might perform a serviceable task for Mineralogy, by bringing forward a Characteristic available to the student possessed of less mathematical knowledge than that presupposed by the system of Mohs; and he would most willingly have contented himself with this performance merely, and have left it for those persons who might find it for their convenience to employ it, to seek elsewhere the requisite knowledge of Terminology, but that he was unable to point them to any single work from which they might derive this information. He has therefore collected and digested, into a form the most perspicuous in his power, just that amount of Terminology which he believed would answer the end in view. This he has done in the order pursued by Mohs; though a different view altogether has been presented of the subject of Crystallography. The distinctions with respect to individuality in the mineral kingdom—what is a simple and what a compound mineral—the distinct consideration of the properties of simple and compound minerals, as well as the treatment of the property of Hardness, are in close imitation of Prof. Mohs; whose words it was so often found necessary to quote, from the impossibility of condensing them more highly, that for the sake of convenience, acknowledgement for the liberty taken has been reserved to be made in the present summary manner. Scarcely less in conformity with the plan of the above mentioned treatise, the author has drawn up a view of the more theoretical, but no less important, departments

of Classification, Nomenclature, Characteristic and Physiography. The study of these branches of Mineralogy is indispensable to the student who would comprehend the true philosophy of the science. And certainly, no mind possessed of a laudable spirit of inquiry can be willing to rest in the mere practice of Mineralogy; it will desire to understand the nature of those general ideas which facilitate this art, as well as those which are otherwise involved in the pursuit.

In the treatment of Crystallography, the author has followed the elementary treatise of BROOKE before alluded to, whose system of primitive forms and method of illustrating their modifications, he has adopted with very little alteration; having experienced in his own case and witnessed in others, how well suited they are both to the determinative and descriptive parts of Mineralogy. He has also drawn largely from the excellent article on crystallization, in the *Dictionnaire des Sciences Naturelles*, written by A. J. M. BROCHANT DE VILLIERS.

It will be seen, then, that the present treatise aims especially to aid persons who would acquire a knowledge of Mineralogy independently of personal instruction, and the advantages of a completely arranged cabinet. It even adapts itself to the wants of those who are unacquainted with the first rudiments of Geometry; nor does it require any, the least, knowledge of Chemistry, in order to its being perfectly comprehended in all its parts.

It requires to be observed, however, that the department of Physiography is not embraced in the present volume. Those who make use of it therefore, will have occasion to consult some other treatise for full descriptions of the species, and the various collateral information usually found in

connection with this department of the science. The author has, however, in the course of preparation a volume devoted to descriptions, drawn up in conformity with the rules of Physiography, as laid down in this treatise, (§. 126). Each species will be described under the trivial name by which it is designated in the Characteristic of this work; and the order in which they will be arranged, will be *alphabetical*, with a view to favor easy reference; against which arrangement there can be no objection urged, since the use of the descriptions always presupposes a knowledge of the names.

The beginner in Mineralogy will by no means think of perusing the Characteristic in order to obtain a knowledge of minerals. This contrivance has for its object solely the recognition of minerals,—always presuming that they are in our hands. Having ascertained the name, the next step in course, is to arrive at a general conception of the species: this is effected through the Physiography. It is almost needless to remark, that it would be equally useless to study the descriptions to effect the determination of minerals.

Still less can it be recommended to the student to arrange his collection in conformity with the Artificial System herein proposed. He has no interest in the classes and orders, or in the succession observed among the species, except so far as they relate to the naming of minerals. To arrange a cabinet of specimens according to a System invented solely to conduct to their names, would be like preserving the staging about an edifice after its construction was completed. The two Systems according to which collections of minerals will undoubtedly continue to be arranged, are the Chemical and the Natural-historical; the former of which will have its adherents among Chemists, and the latter among

Naturalists. A view of both of these, for the convenience of those who possess collections, will be annexed to the second part of the work alluded to above.

The trivial names are employed in the Characteristic as has been already remarked, in all those cases where they are possessed of them; in other instances, they are designated by their chemical or natural-historical epithets. To avoid however, in two instances of recently discovered American minerals, the long, chemical designations bestowed upon them by Dr. THOMSON, the author has ventured upon two new names: one case is that of the *Bi-silicate of Magnesia* of Bolton, Mass., the other is that of the *Ferruginous silicate of Manganese* of Stirling, New-Jersey; the the former, he has called *Boltonite* to commemorate a celebrated deposit of minerals, and the latter *Troostite*, in honor of Dr. TROOST,—a gentleman whose services and accomplishments in Mineralogy are too well known to require any apology for this employment of his name.

But while the present treatise was primarily intended to answer the wants of private students, the author regards it as no less applicable to the circumstances of those who enjoy personal instruction. No oral communications can be a substitute, surely, for an acquaintance with Terminology. This constitutes in fact the preliminary occupation of the Lecturer on the science; and it is here chiefly, that the Instructor who possesses the requisite models and specimens renders an important service to the pupil. The way in which this department is treated in the present work,—being that of a series of connected propositions, will favor the important exercise of recitation and review, which is the only method by which the Teacher can satisfy himself, whether

the pupil is qualified to enter upon the other departments of of the science. For nothing, it will readily be conceded, is calculated to produce a more unhappy effect upon the attainments of the pupil, than to enter upon the determinative and descriptive parts, without the requisite familiarity with the preliminary considerations of Terminology. It is pursuing a course equally injudicious with that of studying Trigonometrical Analysis, while ignorant of Algebra.

Such teachers as may have occasion to use this treatise, and as would wish to employ it in conformity with the views with which it was written, will adopt a course with their pupils, considerably different from that now in use. The Characteristic, instead of the general descriptions, is intended to succeed to Terminology. The pupil must be assisted to determine a few minerals in each order, and then be thrown upon his own resources and referred directly to the mineral kingdom. Indeed the author cannot acquiesce in the method so often pursued of attempting to illustrate to the beginner in succession, the general descriptions of the species by the exhibition of specimens. The utility of this practice, it is believed cannot be made to appear. In many instances, it seems to be practiced with a view to familiarize the student with Terminology; but this should have been acquired systematically by itself, as the preliminary to every other knowledge of minerals.

The duty of the Teacher of Mineralogy appears to be best discharged, when he has led his pupils through the consideration of the properties of minerals, exercised them with the Characteristic, and engaged them fully in the practice of the science; to which may be added, the opening to them eventually of a collection of specimens, arranged so as to exhibit the most important relations of the species, as well as to illustrate the contents of each in all the se-

ries of its properties. A class thus instructed, it is believed will soon become skilful in the practice of the art, and be able to form a proper conception of the contents of the mineral kingdom. As to what relates to the geographical and geological distribution and economical uses, as well as to the literature of the science, this will best be learned from books; and cannot with advantage form a part of the elementary communications of the Lecturer. The same may be said of the chemical composition of the species; a kind of information which may be introduced properly enough into an extended course of instruction on the science to which it relates, but, which should wholly be excluded from early lessons on Mineralogy.

The author trusts that he has not overlooked in his Characteristic any well authenticated species of minerals. To avoid this, he has had constantly at hand not only the most recent treatises on Mineralogy in English, French, and German, but likewise the Scientific Journals in these Languages, as well as those in Swedish; and he hopes that as a recent catalogue of mineralogical species, his work may afford some interest to more advanced students than those for whom it was expressly prepared.

CHARLES U. SHEPARD.

New Haven, June 1st, 1832.

TABLE OF CONTENTS.

INTRODUCTION.

Page.

§. 1. Compass of the Mineral Kingdom, ... 1
§. 2. Different kinds of Knowledge relating to Minerals, . . 2
§. 3. Principal Heads of Mineralogy, ... 3
§. 4. Terminology, ... 3
§. 5. Classification, ... 3
§. 6. Nomenclature, ... 3
§. 7. Characteristic, ... 3
§. 8. Description, ... 3
§. 9. Method to be followed in acquiring a knowledge of Mineralogy, 4
§. 10. Individuals, ... 4

PART I.

TERMINOLOGY.

Introductory.

§. 11. Individuals produced by Crystallization, ... 6
§. 12. Imperfectly formed Minerals, ... 6
§. 13. Decomposed Minerals, ... 7
§. 14. Simple Mineral, ... 8
§. 15. Compound Mineral, ... 8

Page.

§. 16. Mixed Mineral, ... 8
§. 17. Properties of Minerals, ... 9
§. 18. Division of the Natural Properties, ... 9

Section I.

§. 19. Crystal, ... 11
§. 20. Object of Crystallography, ... 11
§. 21. Planes or Faces, ... 12
§. 22. Edges, ... 13
§. 23. Plane Angle, ... 13
§. 24. Solid Angle, ... 14
§. 25. Similar Faces, ... 14
§. 26. Similar Edges, ... 14
§. 27. Similar Plane Angles, ... 14
§. 28. Similar Solid Angles, ... 15

Considerations upon the connexion among crystals, and the relations upon which it depends.

OBSERVATIONS.

§. 29. Certain Mineral species affect peculiar crystalline Forms, 16
§. 30. Different Forms in the same species, ... 16
§. 31. Derivation of different Forms within a species, . . . 18

Consideration of fundamental or primary Forms, and of some of their geometrical relations.

§. 32. Primary Forms, ... 18
§. 33. The Cube, ... 19
§. 34. The regular Tetrahedron, ... 19
§. 35. The regular Octahedron, ... 20
§. 36. The rhombic Dodecahedron, ... 21

Page.

§. 37. The Octahedron with a square base, ... 22
§. 38. The Octahedron with a rectangular base, ... 22
§. 39. The Octahedron with a rhombic base, ... 23
§. 40. The right square Prism, ... 23
§. 41. The right rectangular Prism, ... 24
§. 42. The right rhombic Prism, ... 25
§. 43. The right oblique-angled Prism, ... 25
§. 44. The oblique rhombic Prism, ... 26
§. 45. The doubly oblique Prism, ... 27
§. 46. The Rhomboid, ... 29
§. 47. The regular hexagonal Prism, ... 31

Consideration of the changes to which the Primary Forms of Crystals are subject.

§. 48. Modifications of Primary Forms, ... 31
§. 49. Kinds of Modifications, ... 32
§. 50. Disposition of Secondary Planes regulated by symmetrical Laws, ... 33
§. 51. Passage of one Form into another, ... 48

Of the imperfections of Crystals in respect to their Form.

§. 52. Kinds of Imperfection in Form, ... 56
§. 53. Irregularities depending upon the Formation of the Individuals themselves, ... 56
§. 54. Irregularities from contact with other Individuals, . . 58
§. 55. System of Crystallization, ... 59
§. 56. Series of Crystallization, ... 60
§. 57. Methods for ascertaining the Angles of Crystals, . . 61
§. 58. Structure, ... 68
§. 59. Cleavage, ... 68
§. 60. Cleavage Planes, ... 69

Page.

§. 61. Direction of Cleavage constant, ... 69
§. 62. Form of Cleavage, ... 69
§. 63. But one Form of Cleavage (generally) in the members of a species, ... 72
§. 64. Relation between Forms of Cleavage and Crystals, . . 72
§. 65. Relation between Forms of Cleavage and Primary Forms, 75
§. 66. Primary Form, in the Absence of Cleavage, how established, 75
§. 67. Directions for ascertaining the Primary Forms of Crystals, 76
§. 68. Fracture, ... 79
§. 69. Kinds of Fracture, ... 79
§. 70. Surface, ... 80

Section II.

Compound Minerals.

§. 71. Regular and Irregular Composition, ... 82
§. 72. Regular Composition of two Individuals, ... 83
§. 73. Regular Composition of more than two Individuals, . . 89
§. 74. Irregular Composition. Groupe and Geode of Crystals, 90
§. 75. Imitative Shapes, ... 90
§. 76. Imitative Shapes originating in the Groupes of Crystals, 91
§. 77. Imitative Shapes arising out of the Geodes of Crystals, 91
§. 78. Amorphous Composition, ... 93
§. 79. Accidental Imitative Shapes, ... 94
§. 80. Regular Accidental Imitative Shapes.—Pseudomorphoses, 94
§. 81. Irregular Accidental Imitative Shapes, ... 97
§. 82. Particles of Composition, ... 98
§. 83. Single and Multiple Composition, ... 100
§. 84. Characteristic Marks of Composition, ... 100
§. 85. Structure of Compound Minerals, ... 102

Page.

SECTION III.

The natural properties common to both Simple and Compound Minerals.

§. 86. Division, ... 103

The Optical Properties of Minerals.

§. 87. Lustre, Color, Transparency, ... 103
§. 88. Kinds and Intensity of Lustre, ... 104
§. 89. Series in the Differences of Lustre, ... 106
§. 90. Division of Colors, ... 106
§. 91. Metallic Colors, ... 107
§. 92. Non-Metallic Colors, ... 107
§. 93. Series of Colors, ... 111
§. 94. Peculiarities in the Occurrence of Colors, ... 111
§. 95. The Streak, ... 113
§. 96. Degrees of Transparency, ... 114

The Physical Properties of Minerals.

§. 97. State of Aggregation, ... 115
§. 98. Hardness, ... 116
§. 99. Specific Gravity, ... 120
§. 100. Magnetism, ... 123
§. 101. Electricity, ... 123
§. 102. Taste, ... 124
§. 103. Odor, ... 124

PART II.

CLASSIFICATION.

§. 104. Identity, ... 130
§. 105. Difference, ... 132

Page.

§. 106. Species, ... 132
§. 107. Transitions, ... 133
§. 108. Two kinds of Classification, ... 134

Analytical System.

§. 109. Division of the Mineral Kingdom into Classes, . . 139
§. 110. Division of the Crystallized Class into Orders, . . 141
§. 111. Division of the Semi-Crystallized Class into Orders, . 141
§. 112. Division of the Uncrystallized Class into Orders, . . 142
§. 113. Arrangement of the Species within the Orders, . . 153

Part III.

NOMENCLATURE.

§. 114. General Object of Nomenclature, ... 144
§. 115. Systematic Nomenclature, ... 144
§. 116. Trivial Nomenclature, ... 145
§. 117. Nomenclature in an Analytical System, ... 146

Part IV.

CHARACTERISTIC.

§. 118. Definition, ... 147
§. 119. Properties of the Characters, ... 147
§. 120. Characters of the Classes and Orders, ... 148
§. 121. Characters for the Species, ... 148
§. 122. Use of the Characteristic, ... 150
Characters of the Species in Class I, ... 154
Characters of the species in Class II, ... 202
Characters of the Species in Class III, ... 212
Alphabetical list of imperfectly examined Minerals, . . . 243

REESE LIBRARY OF THE UNIVERSITY OF CALIFORNIA.

Part V.

PHYSIOGRAPHY.

Page.

§. 123. Definition, ... 249

§. 124. Objects of Physiography, ... 250

§. 125. General Description of the Species, ... 251

§. 126. Arrangement of the General Description, . . . 252

§. 127. Collective Descriptions independent of all Systems, . 255

§. 128. Additional Information appended to the Collective Descriptions, ... 255

ERRATA.

Page.	*Line.*	*Error.*	*Correction.*
16,	9,	as,	is.
18,	16,	adapted,	adopted.
103,	26,	characters,	properties.

Omissions in a part of the edition.

214, insert between lines 21 and 22, a line of separation.
226, 6th line, insert ¶ before Dolomite.
238, 9th " " ¶ " Iolite.
238, 16th " " ¶ " Dysluite,

INTRODUCTION.

§. 1. Compass of the Mineral Kingdom.

The Mineral Kingdom includes all inorganic, natural productions.

Natural productions are divisible into two great classes; the one consisting of *organic*, the other of *inorganic* bodies. These classes have nothing in common, except the general properties of matter. Organic bodies are composed of integrant parts essentially different in the same individual, in their consistence and composition, no less than in their situation and use; while inorganic bodies, on the contrary, are made up of similar particles, any of which taken separately present the properties of the whole. The growth, or formation of inorganic bodies is dependent solely upon molecular attraction; whilst in the other class, the arrangement of the particles is influenced by an additional force often conducting them by a long and circuitous route before they reach their appropriate deposits: this modifying force is known under the name of vitality. When the power which governs the formation of inorganic bodies has completed its action, the bodies remain in a passive state; and the disunion of their molecules, by any external force, destroys their existence. Organic bodies, on the other hand, are never in a passive state. They constantly accumulate, and part with, new molecules; and cease to exist, when the acquisition of additional particles can no longer take place.

Inorganic bodies are altogether comprehended under the name of *Minerals*. An attempt has been made to divide the inorganic class into two divisions, according as they constitute the solid mass of the globe, or the fluid mass of the atmosphere; and hence the distinction which has been proposed of *Atmospherilia* and *Fossils*. But, as it refers solely to the state of bodies, whether they are gaseous or concrete, and to their situation, whether within the earth or around it, it obviously possesses, too slender grounds to be proposed as a logical distinction; and has not, accordingly, been acknowledged by the majority of naturalists. The term, *fossil*, is at present more

correctly applied to denote organic remains, found imbedded in the earth.

§. 2. Different kinds of knowledge relating to Minerals.

Minerals may be studied as so many different objects with a view to their recognition: this kind of information is denominated *Mineralogy*. Minerals may be studied again, with a view to learn their composition, or their chemical relations: this knowledge forms a part of *Chemistry*. They may be studied also for the purpose of elucidating the general structure and arrangements of the earth: this pertains to *Geology*. They may be studied as respects their distribution over the face of the earth: this is a branch of *Physical Geography*. Finally, they may be studied with regard to their applications to the arts: this is a part of *Economy*.

The relations which exist between the different kinds of knowledge just enumerated are very important. Mineralogy may indeed be said to be independent of all the other sciences which relate to minerals, having nothing to perform except their determination, and the description of their natural properties. But, Chemistry requires the information which it is the business of Mineralogy to supply at the commencement of its inquiries concerning these bodies, in order to designate the objects about which its peculiar researches are employed. Geology in like manner presupposes a considerable acquaintance with Mineralogy, for it is impossible for mountain masses to be distinguished except from a mineralogical knowledge of their ingredients; and Economy cannot avail itself of substances which it is unable to recognize, or Geography indicate the distribution of objects whose names are unknown. Mineralogy enables us to apply to minerals whatever is taught in other sciences, by determining the objects treated of by them; and its true value becomes apparent, if we reflect that whatever knowledge we may possess concerning minerals, it is little better than useless, if we

are unable to indicate with certainty the particular species to which it belongs.

§. 3. Principal Heads of Mineralogy.

The development of Mineralogy involves the following general heads: viz. 1. *Terminology*, 2. *Classification*, 3. *Nomenclature*, 4. *Characteristic*, 5. *Description*.

§. 4. Terminology.

Terminology consists in an explanation of the natural properties employed in recognizing and describing minerals, and of the language or technical terms used in this explanation.

§. 5. Classification.

Classification settles the idea of the species, and the principles upon which their arrangement depends.

§. 6. Nomenclature.

Nomenclature furnishes the names and denominations applied to minerals.

§. 7. Characteristic.

The characteristic is confined to certain marks, or differences, arranged systematically, for the purpose of enabling us to distinguish the members of one division, class, or species from those of another.

§. 8. Description.

The description of minerals consists in an enumeration of all their natural properties; and is intended to produce a distinct image of individuals.

§. 9. Method to be followed in acquiring a knowledge of minerals.

The course to be adopted by persons aiming at a thorough acquaintance with the inorganic kingdom, consists, in the first place, in studying the properties of these bodies, and in acquiring a knowledge of the terms by which they are designated. This will require as a preliminary, a familiarity with a few definitions in geometry; and afterwards, access to a collection of minerals arranged on purpose to illustrate the properties in question. The remaining principles of Mineralogy being understood, the student should apply himself at once to the Characteristic, or the means of arriving at the names of unknown minerals through the use of the artificial system: the names attained, he will be led, by having recourse to an alphabetical index, without farther inconvenience, to a full account of their nature from the *catalogue of species*, in which all the knowledge possessed, concerning minerals, is systematically detailed.

After his acquaintance with the majority of the species is formed, he will be prepared to enter upon that higher and more interesting field, where the affinities of the different species are sought out with a view to discover the more comprehensive unities of genera, orders and classes which exist in the science, and whose survey is always attended with a high degree of satisfaction, as offering to the mind, at a single glance, the various degrees of resemblance with which nature itself has impressed her own productions.

§. 10. Individuals.

An inorganic production which is a single body is considered as an *Individual* in the mineral kingdom.

A crystal of Quartz, Iron-pyrites, or Topaz, is an individual in the highest sense of the word, since within the space occupied by its form, there exists a similar kind of matter in a state of insular existence, being every where cut off from union with other individuals of the same, or of different kinds of matter. A distinct concretion of granular Limestone is also an individual, although circumstances have prevented it from assuming its regular shape. Such productions are to be viewed as independent *wholes*, and capable of consideration without regard to their connexion with other individuals;

in the same manner as an entire plant, or an entire animal is capable of the same process.

There are many inorganic bodies incapable of being considered as wholes; because they are not limited toward their boundaries in any determinate manner. To such belong Water, Atmospheric-air, and in general, those bodies which are fluid at natural temperatures. They may, and undoubtedly do, consist of a great many individuals; but the imperfection of our organs place them beyond the reach of examination, and compel us to study them in masses. In this situation with respect to these bodies, we may indeed compare our case with that of the botanist who is permitted to view a verdant mass of vegetation only from a distance, instead of examining nearer by, the individual forms of which it is composed.

PART I.

TERMINOLOGY.

INTRODUCTORY.

§. 11. Individuals produced by Crystallization.

The power which gives rise to individuals, is called Crystallization.

When minerals assume the state of individuality, or in other words, pass from the fluid to the solid state, they acquire not only regularity of shape, but cohesion, weight, and different relations to light; and, hence, these properties, also, must be considered as the products of crystallization. Their entire assemblage in any one case, is the mineral itself; at least so far as it is an object of Mineralogy.

Minerals upon which the power of crystallization has never exerted its force, are destitute of these properties, and accordingly not possessed of individuality. They are mere shapeless masses which find a place in the mineralogical system, only, because they are natural productions.

Temperature exercises a controlling influence over the crystallization of minerals. Water and Mercury assume the condition of individuality if their temperature be sufficiently reduced; while on the on the other hand, Native bismuth, Silver and many others resign this state, and become liquid, if their temperature is elevated to a certain point. On this account, it becomes necessary to fix the degree of temperature in which minerals shall be considered; and the ordinary temperature, in which water is fluid, has accordingly been agreed upon.

§. 12. Imperfectly formed Minerals.

Those minerals are said to be imperfectly formed, which are deficient in any of those properties, which distinguish the finished productions of crystallization.

In these bodies the power of crystallization appears to have been interrupted during their formation, and they have accordingly been left in an incomplete state. Examples of this kind may be seen in uncrystallized Quartz, massive Garnet, and common Feldspar. Such minerals are in a similar condition with the defective or monstrous individuals occurring in the organic kingdom. It will not appear strange, moreover, that they should on the whole be much more numerous among inanimate bodies than among living beings; since the individualizing power in the former, beside being confined to a single cause, viz. that of crystallization, (§. 11.) is liable to be affected by a much greater variety of accidents than the latter.

§. 13. Decomposed Minerals.

Decomposed minerals are those which have lost some of those properties derived from the power of crystallization.

Decomposed minerals are, either, only impaired in the color, luster, and hardness of their crystals, while the form is preserved, as is the case with Laumonite, or they are reduced to the form of powder and shapeless masses, wholly destitute of regular structure, lustre, or constant degrees of hardness, and specific gravity, as in the instance of Porcelain clay, derived from the decomposition of Feldspar. Such bodies, obviously, are no more proper objects of mineralogical determination than are the decayed portions of a plant of botanical consideration. Still, it will generally be possible to discover what a decomposed mineral has been in its natural state, though to effect this we must employ a different method from that adopted in determining other minerals.

Decomposed minerals are of rare occurrence, except at the immediate surface of the earth, where minerals are exposed to a variety of mechanical forces in addition to the chemical agency of heat, air, and moisture. Still the progress actually made by these disintegrating and decomposing agents is very limited. Many minerals continue to preserve the integrity of their characters, though almost impalpably reduced in size; and immense surfaces of rock remain apparently unaltered from age to age amidst this incessant warfare.

§. 15. Simple Mineral.

A single individual, or a part of one, in the inorganic kingdom is called a *simple mineral.*

A crystal of Quartz, or a fragment of one is therefore a simple mineral: a distinct concretion of Limestone is likewise a simple mineral. No allusion to the chemical composition of a mineral is to be understood by the term simple: a simple mineral may be composed of a single element as is the fact with regard to a crystal of Diamond, or it may be composed of several as in a crystal of Emerald.

§. 15. Compound Mineral.

An inorganic substance consisting of more than one individual of the same kind is called a *compound mineral.*

Examples of compound minerals may be seen in specimens of Fluor made up of many distinct crystalline masses, or in a mass of granular Limestone or fibrous Haematite. They are produced whenever several individuals of the same kind are formed within a common space where the contact is too close to allow of their assuming their regular form. Therefore the individuals which form a compound mineral, do not possess regularity.

§. 16. Mixed Mineral.

A mixed mineral consists of two or more simple minerals of different kinds united together.

Granite, which is an aggregate formed of Quartz, Feldspar and Mica, is a mixed mineral. Porphyries, Lavas and most Slaty rocks are of the same denomination. With these, Mineralogy has no concern; it having already performed its duty as respects them in ascertaining the nature of their ingredients, or, in other words, of the simple minerals which compose them.

§. 17. Properties of Minerals.

The properties, or characters of minerals may be said to be of two kinds: the first consisting of those which minerals exhibit while in their natural state; and the second of those observed during, or after a change has been produced in their nature. The former of these are termed Natural characters; the latter Chemical characters.

The natural characters comprehend their color, different degrees of hardness and transparency, the kinds of lustre, the regular forms, the various sorts of aggregation under which compound minerals exist, the specific gravity and taste of minerals. The chemical characters are those whose use effects the decomposition of a mineral, or which induce an obvious alteration in its state; of this kind are the fusibility of minerals, or their behavior before the blowpipe, their solubility in acids and the accompanying phenomena, phosphorescence by heat, and chemical analysis with a view to learn the quality of the composing ingredients and the order in which they are present.

The natural characters only, are employed either in the Description or Characteristic of the science. The chemical characters appertain to Chemistry, and require to be enumerated and explained in a mineralogical work, merely to render intelligible the results of Chemistry, which are appended to the descriptions of minerals, with the design of enlarging, as far as possible, our knowledge of these bodies.

§. 18. Division of the Natural Properties.

The natural properties of minerals are divided into, 1. Such as refer to *simple;* 2. Such as refer to *compound minerals;* 3. Such as are common to *both.*

The first division will consist of those which can be observed only in an individual itself, or in a fragment of an individual. To such belong the *geometrical properties,* or such as refer to *space;* the relations of *structure,* of *surface,* and the phenomena of refraction. The second division embraces the relations of *composition,* the

forms of compound minerals, and the mode of *junction* of the individuals of these compositions. The third division relates to those characters which are not affected by the simple or the compound nature of the mineral; as color, lustre, transparency, hardness, specific gravity, the state of aggregation, magnetism, electricity, taste and odor.

The Terminology of the science will, therefore, be treated of in three sections, to which will be added, in notes, some account of the chemical characters, since these fall rather within the science of Chemistry than of Mineralogy.

PRESS LIBRARY OF THE UNIVERSITY OF CALIFORNIA.

SECTION I.

§. 19. Crystal.

The term *crystal* is applied to a body consisting of continuous, similar matter, which has been formed by nature, within a regularly limited space.

It is necessary to the idea of a crystal, that the entire space it occupies should be made up of particles, between which there is no distinguishable difference, except indeed those variations which may occasionally arise out of the relations of light. This limitation is requisite in order to exclude certain minerals found under regular shapes and composed of similar matter, but between whose particles there is observed an evident distinction. Of this sort are what are denominated pseudomorphous crystals, between which, and the bodies intended to come under the above signification, there exist too many dissimilarities to allow their being treated of together.

The term crystal cannot be extended either to such minerals as require, in order to present a regular shape, to have any of their parts detached: since it is requisite by the above definition that a crystal should be left by *nature* within a regularly limited space.

The idea of transparency which mankind in general attach to crystals is of course incorrect, as the largest portion of these bodies are opaque.

§. 20. Object of Crystallography.

The object of *Crystallography* is to ascertain the form of crystals, with a view to explain the relations and differences existing among them.*

---

* *History of Crystallography.*—The knowledge of the fact, that inorganic substances affect a great variety of regular shapes, appears to have been prevalent at an early period. Several of the precious stones,

§. 21. Planes or Faces.

The surfaces which limit a crystal are termed its *planes* or *faces*.

The surface of crystals are not always perfectly plane, being sometimes slightly spherical, as in some particular modifications of the Diamond; although in crystallography they are considered as perfect *planes*.

---

as the Diamond, the Emerald, and the Topaz, as well as the ores of certain metals, and the many earthy minerals occurring in metallic veins, as Quartz, Heavy-spar and Fluor were among the instances of crystallized minerals the most familiar to mankind. Notwithstanding, several of these forms were known to be constant in their shape, besides being identical with some of the regular solids of geometry, still they continued until the time of Linnæus, to be regarded as the results of mere accident or chance. This philosopher appears to have been the first to consider them as the products of fixed laws, and to imagine that the study of their relations might be of utility in the recognition of minerals. In 1772, Romé de Lisle published the first general treatise upon crystallography; in which he made known a great number of crytals never before noticed by naturalists. He determined the angles of their planes, and established the important fact, that *the angles are invariable among the individuals of the same variety.* Afterwards, Bergmann and Haüy made a contemporaneous observation relative to the internal structure of crystals, from which they inferred, that *the direction of the cleavage was constant in all crystals of the same substance, whatever might be their form.* From this fact Bergmann contented himself with forming the supposition that the various forms assumed by the different individuals of any one substance, might be conceived to flow from a single parent or derivative form, through the operation of certain decrements, upon its edges and angles. But Haüy verified the observation concerning cleavage, in every species in which it was possible to discover the natural joints, and by connecting with it, his ingenious theory relating to the forms and dimensions of the molecules, of which he conceived the primary forms were composed, he proceeded to unfold, mathematically, the laws of decrement by which the secondary forms might be produced; and thus elevated crystallography to the rank of a geometrical science.

The planes, or faces of a crystal receive certain names according to these faces, as for instance, *triangular faces, rhombic faces,* &c.; and also according to the forms which they limit, as *faces of the Cube, of the Octahedron,* &c.

§. 22. Edges.

The lines produced by the meeting of the planes or faces are termed *edges.*

The edges are denominated, not only according to the forms to which they belong, but also as respects their peculiar situation in these forms, as will be illustrated hereafter.

§. 23. Plane Angle.

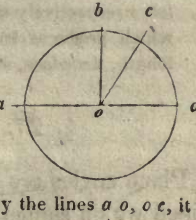
The meeting of any two edges forms a *plane angle.**

---

* *Elementary definitions.—The measure,* or, as it is sometimes termed, the *value of an angle,* is the number of degrees, minutes, &c. of which it consists; these being determined by the portion of a circle which would be intercepted by the two lines forming the angle, supposing the point of their meeting to be in the centre of the circle. For the purpose of measuring angles, the circle is divided into 360 equal parts, which are called *degrees;* each degree into 60 equal parts which are called *minutes;* and each minute into 60 *seconds;* and these divisions are thus designated: 360°, 60′, 60″,—the ° signifying degrees, the ′ minutes, the ″ seconds.

If ¼ of the circle, or 90°, be intercepted by the two lines *a o, o b,* Fig. 1, which meet at an angle *a o b* in the the centre, those lines are perpendicular to each other, and the angle at which they meet is said to measure 90°, and is termed a right angle. If less than ¼ of the circle be so intercepted, as by the lines *b o, o c,* the angle *b o c,* will measure less than 90°, and is said to be *acute.* If it measure more than 90°, as it would if the angle were formed by the lines *a o, o c,* it is called *obtuse.*

Fig. 1.



§. 24. Solid Angle.

The meeting of three or more plane angles forms a *solid angle.*

The solid angle is denominated according to the particular form in which it is found, and also agreeably to its situation and quality. Thus we say, solid angles of the Octahedron, prismatic solid angles, &c.

§. 25. Similar Faces.

Those faces of a regular form are said to be *similar* to one another, whose corresponding edges are proportional, and whose corresponding angles are equal.

In crystals, similar faces are not always equal to each other in their dimensions. Sometimes a single face is more enlarged than the rest. In such a case, its similarity is inferred from its situation. Crystallography, in developing the relations of crystals to each other, takes no notice of such irregularities, inasmuch as they are accidental; but investigates their forms as they are presented in their highest regularity and perfection.

§. 26. Similar Edges.

Edges are said to be *similar* when formed by the meeting of faces equally inclined to each other.

In crystals, the length of the edges, produced by the meeting of faces respectively similar, is liable to variation from the same cause which produces irregularities among similar faces. Disparity in length, therefore, does not affect the idea of their similarity.

§. 27. Similar Plane Angles.

Plane angles are *similar* when they are equal, and contained within similar edges, respectively.

§. 28. Similar Solid Angles.

Solid angles are similar when formed of an equal number of plane angles, of which the corresponding ones are similar.

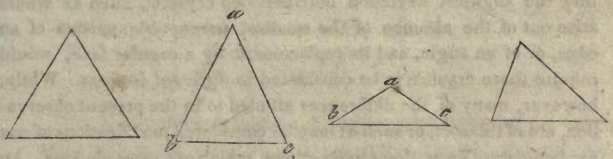
Similar solid angles may be wholly made up of similar plane angles; or there may exist a degree of dissimilarity among them, provided this dissimilarity corresponds in both: in the former case they are said to be *equiangular*, and in the latter *unequiangular*.

A solid angle, formed of three, four, five, &c. faces, is said to be a solid angle of three faces, a solid angle of four faces, &c.*

---

* *Elementary definitions.*—A *triangle* is a plane figure contained within three sides. When the sides are equal it is called an *equilateral triangle*. Fig. 2. The angles of an equilateral triangle are equal. A triangle having but two equal sides is called an *isosceles triangle*. Fig. 3, and 4. In Fig. 3, the two equal sides contain an angle less than 90°; and in Fig. 4, an angle greater than 90°; Fig. 3, is therefor ecalled an *acute triangle*, and Fig. 4, an *obtuse triangle*. The unequal side *b c*, is termed the base of the triangle. The angles *a b c* and *a c b*, which are adjacent to the base, are equal to one another. A triangle with all its sides unequal is termed a *scalene triangle;* Fig. 5, in which, all the angles also, are unequal.

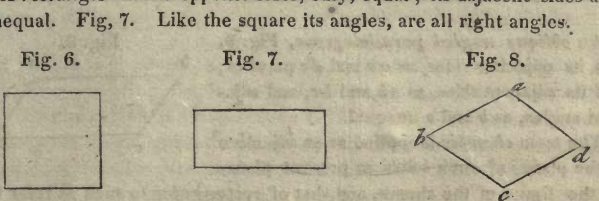
Fig. 2. Fig. 3. Fig. 4. Fig. 5.



A *square* has four equal sides. Fig, 6. Its angles are right angles.

A *rectangle* has its opposite sides, only, equal; its adjacent sides are unequal. Fig, 7. Like the square its angles, are all right angles.

Fig. 6. Fig. 7. Fig. 8.



A *rhomb* has four equal sides. Fig. 8. Two of its angles, as *a* and *c* are obtuse; the other two, *d* and *b*, are acute.

CONSIDERATIONS UPON THE CONNEXION AMONG CRYSTALS, AND THE RELATIONS UPON WHICH IT DEPENDS.

OBSERVATIONS.

§. 29. Certain mineral species affect peculiar crystalline forms.

Numerous observations have fully established the fact, that certain geometrical forms are constantly found in connexion with certain mineral substances, while others are never seen in such connexion. Thus the Cube, as found in Common Salt, the hexagonal Prism in the Emerald, the rhombic Prism in Heavy Spar, and the Rhomboid in Carbonate of Lime: while the hexagonal Prism is never found in Common Salt, the Rhomboid in Emerald, or the Cube in Carbonate of Lime.

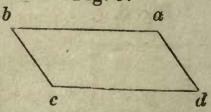
§. 30. Several different forms are frequently found in the different individuals of the same species.

In this observation, (which limits §. 29,) it must be understood, that the slightest deviation between two crystals, such as would arise out of the absence of the smallest perceptible portion of an edge, or of an angle, and its replacement by a regular face, would require these crystals to be considered as *different in form.* While, however, many of the differences alluded to in the present observation, are of this sort, or such as may be considered modifications of one predominating form, there exist others, which are more obvious. An

---

An *oblique angled parallelogram,* Fig. 9, has its opposites sides, as *a b* and *d c* parallel; but its adjacent sides, as *a b* and *b c*, and adjacent angles, as *b* and *c* unequal.

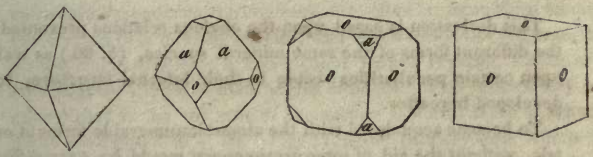
Fig. 9.



The term *rhombic* is applied as an adjective to the planes of such solids as present planes of the figure of the rhomb, and that of *rectangular* to such as refer to the rectangle.

example of both these kinds of difference may be seen in the crystals of Iron Pyrites, Figs. 10, 11, 12, and 13;

Fig. 10. Fig. 11. Fig. 12. Fig. 13.



in those of Carbonate of Lime, Figs. 14, 15, and 16;

Fig. 14. Fig. 15. Fig. 16.

and in those of Uranite. Figs. 17, 18, and 19.*

Fig. 17. Fig. 18. Fig. 19.

The different forms in each of these substances have a constant uniformity in the value of their respective angles; and individuals belonging to them, though from the most remote situations, present not the slightest variation in this respect.

---

* Fig. 11 is obviously, a mere modification of Fig. 10; Fig. 12 of 11, the difference being, that in 12, the faces *o* are considerably more extended than in 11; 13 is a modification of 12, in which the faces *o* are produced so as to extinguish the planes *a*, seen in 11 and 12. Between Figs. 14 and 15, the difference is not so easily explained; while, we have only to conceive of the enlargement of *c* at both extremities of the prism, Fig. 15, in order to form Fig. 16.

§. 31. The different crystalline forms belonging to each species may be conceived to be derived, by certain laws, from one type, or fundamental form.

This derivation is based upon the obvious relations presented by the different forms of the same mineral species, (§. 30.) as well as upon certain peculiarities visible in their internal structure, to be developed hereafter.

To become acquainted with the almost innumerable forms of crystals, without the aid of some arrangement would be very difficult. The preliminary study of the fundamental forms therefore, from which nature appears to have produced her numerous secondaries, is no less necessary, than it is natural. And it cannot be too strongly insisted upon, that the student in Mineralogy should establish in his mind as clearly as possible, the precise grounds of discrimination among these few important solids, and familiarize himself with the language adapted to denote the peculiar properties of each; since without a perfect familiarity with these points, he will constantly find himself embarrassed in the systematic study of minerals.

CONSIDERATION OF FUNDAMENTAL OR PRIMARY FORMS AND SOME OF THEIR GEOMETRICAL RELATIONS.

§. 32. Primary Forms.

The primary form is assumed to be that particular form from which all the different crystals of a mineral species are derived, in consequence of certain symmetrical changes, it may be supposed to have undergone, during their formation. The primary forms are fifteen in number; 1, the *Cube;* 2, the regular *Tetrahedron;* 3, the *regular Octahedron;* 4, the *rhombic Dodecahedron;* 5, the *Octahedron with a square base;* 6, the *Octahedron with a rectangular base;* 7, the *Octahedron with a rhombic base;* 8, the *right square Prism;* 9, the *right rectangular Prism;* 10, *the right rhombic Prism;* 11, the *right oblique angled Prism;* 12,

the *oblique rhombic Prism*; 13, the *doubly oblique Prism*; 14, the *Rhomboid*; 15, the *regular hexagonal Prism*.

The student must not suppose that the primary form is altogether an imaginary one; on the contrary, it is often an actua lform among the crystals of a mineral species, and when this is not the case, its planes frequently form a conspicuous part of crystals, which are only slightly altered at their angles or edges. This remark may be exemplified in the instance of the species Uranite, three of whose forms are figured in §. 30. Fig. 17 is the primary form which is still observable in Fig. 18 and 19, if we make an abstraction of their edges and angles. There do exist, however, crystals in which it is wholly out of sight; in such cases, it is developed by mechanical means, or inferred to exist according to rules hereafter to be explained.

§. 33. The Cube.

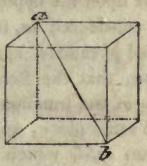
The Cube is contained under six square faces.

All the angles of the Cube are right angles.

An *axis** passes through the centre and through two opposite solid angles; as *a*, *b*, Fig. 20. From its equality in length, breadth, and altitude, the Cube has a similar axis in four directions, or passing through its centre and through each pair of opposite solid angles.

It is a form very often seen among crystals, as in Iron Pyrites, Fluor, Galena, &c.

Fig. 20.



§. 34. The Regular Tetrahedron.

The regular Tetrahedron is contained under four equilateral, triangular faces.

The mutual inclination of its faces, as P on P′, Fig. 21, = 70° 31′ 43″. Its plane angles = 60°.

The axis A*b* passes through the centres of the summit and base, and in consequence of its symmetrical form, it possesses a similar axis in four directions.

Fig. 21.

* An axis is a line, passing through the centre of a solid, drawn from any angular point formed by the meeting of equal plane angles to the opposite angle or face.

The Tetrahedron is the most simple of pyramids, having as many bases as it has planes, and on whichever of these it is placed, it is a similarly formed pyramid. It contains the least solidity under a given surface of any natural or artificial solid. It is not a very frequent form among crystals, occurring only in Grey Copper Ore, and one or two other mineral species.

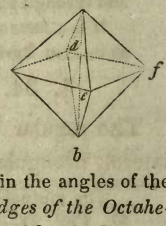
§. 35. The Regular Octahedron.*

The regular Octahedron is contained under eight equilateral triangles.

---

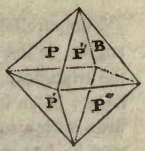
* It may not be superfluous to the student, in Mineralogy, who has had little opportunity for the study of solid geometry, to add here a more general description of the properties of the Octahedron. This figure, then, is a solid terminated, or bounded by eight triangular faces, disposed symmetrically about an axis which they meet, four upon one side, and four upon the opposite side, parallel to the first. The Octahedron may be considered as formed by the reunion of two similar and equal four sided pyramids, applied base to base and edge to edge. It will follow, then, that the four edges, *ce*, *ef*, *fd*, *dc*, Fig. 22. of the junction of the two pyramids, are in the same plane, and that they form a parallelogram *cefd*, which is the common base of the pyramids. These edges, *ce*, *ef*, *fd*, *dc*, are called the *edges of the base*. The four solid angles *c*, *e*, *f*, and *d*, are called the *angles of the base;* the two remaining solid angles *a*, and *b*, the *angles of the summits*, and the line *ab*, which connects them within, is the axis. The edges which join the angles of the summit with those of the base, are called the *upper edges of the Octahedron*. These are eight in number, and are also, four and four in the same plane, and these two planes, *aebd* and *afbc*, are also parallelograms. There are, therefore, in an Octahedron, three diagonal planes, or three parallelogramic sections *cefd*, *aebd* and *afbc*. It is obvious that any one of these may be chosen for the base of an Octahedron, which being selected, the line which joins the two opposite angles, not comprised in the adopted base, will be the vertical axis. There are, then, three bases, and three axes in this solid; but in the crystals which come under

Fig. 22.



Its plane angles = 60°. The inclination of the faces united by its edges, as P on P′, or P″, Fig. 23. = 109° 28′ 16″. The inclination of the faces united by their angles, as P on B = 70° 31′ 43″.

Fig. 23.



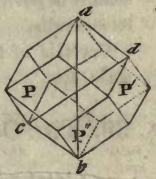
All its solid angles being similar, the regular Octahedron has a similar axis in three directions.

The regular Octahedron is one of the most abundant forms among crystals. It is common in Magnetic Iron Ore, Spinel and Red Oxide of Copper.

§. 36. The Rhombic Dodecahedron.

The rhombic Dodecahedron is contained under twelve equal rhombic faces.

Fig. 24.



This solid has two kinds of solid angles, six acute, and eight obtuse; and two varieties of plane angles. The six acute solid angles, and which consist each of four acute plane angles, are opposite, *two and two;* and the eight obtuse solid angles, consisting each of three obtuse angles, are also opposite, *two and two.*

The mutual inclination of those faces united by their edges, as P on P″ Fig. 24. = 120°. The inclination of those faces united by their acute angles, as P on P′ = 90°. Its plane angles = 109° 28′ 16″ and 70° 31′ 43″.

It has two dissimilar sets of axes passing through its centre; one set, as *ab*, passes through the pairs of opposite, acute solid angles; the other, as *cd*, passes the obtuse solid angles. The former are three, and the latter four, in number. When either of the axes passing through the acute solid angles, is in a vertical situation, the solid is *in position.*

The rhombic Dodecahedron is of frequent occurrence among crystals, of which Garnet and Blende are examples.

---

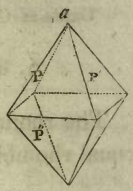
this denomination, the modifications they undergo furnish reasons for adopting a particular base, and a particular axis in preference to the others, except in the case of the *regular Octahedron.* The base being determined upon, when we speak of the axis, we of course refer to the one which is vertical; otherwise, we mean any one of them.

§. 37. The Octahedron with a square base.

The Octahedron with a square base is contained under eight equal, isosceles triangular faces.

The parallelogram formed by the unequal side in each of the triangles, is the base of the Octahedron, which, from the equality of the triangles, is a square. It is obvious from the nature of an isosceles triangle, that in the Octahedron with a square base, the angle at *a*, Fig. 25. may be less, or greater than 60°; when it is less, the Octahedron is called *acute*, when greater, *obtuse*.

Fig. 25.



This form is capable of presenting a variety of angles in its individuals, as respects the inclination of P on P″, and consequently of P on P′.

Its axes will be the same in number as in the regular Octahedron. When the base is horizontally situated, this solid is in *position*, and its upper and lower extremities are termed its summits.

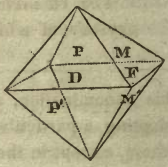
Crystals of the present form are seen in the species Zircon, Anatase, &c.

§. 38. The Octahedron with a rectangular base.

This Octahedron is contained under eight triangular planes, and possesses one rectangular base.

The planes are generally isosceles triangles in this form, though it may happen that four of them may be equilateral, without destroying its rectangular base. It is described, or said to be in *position*, with its rectangular base horizontally situated. The broad planes P, P′, Fig. 26. meet at the edge of the rectangular base, at a more obtuse angle than the narrow ones M, M′. The edge D may therefore be termed the *greater*, and the edge F the *lesser* edge of the base.

Fig. 26.



Like the Octahedron with a square base, the individuals belonging to this form will differ from each other, in the inclination of P on P′, or of M on M′. Its axes and summits are distinguished also, as in the case of that form.

Crystals of this form are found in the species Arseniate of Copper.

§. 39. The Octahedron with a rhombic base.

The Octahedron with a rhombic base is contained under eight equal scalene triangles.

Fig. 27.

The crystals of this form are in position, when the rhombic base is horizontal. Fig. 27 is drawn with the greater diagonal* of the base horizontal. The faces which meet at the edge B, form a more acute angle than those which meet at the edge C. The edge B is therefore denominated the *acute edge* of the pyramid, and the edge C the *obtuse edge* of the pyramid. The solid angle at E is termed the *acute lateral solid angle*, and that at I the *obtuse lateral solid angle*.

The individuals belonging to this class will differ from each other, in the inclinations of P on P′, and of P on P″.

This form is seen in the crystals of Sulphur.

§. 40. The right† square Prism.

The *right square Prism* is a quadrangular‡ prism, whose bases are equal squares, and whose sides are equal rectangles.

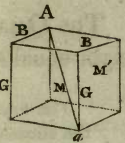
---

* A line connecting the opposite angles of any parallelogram is termed a *diagonal* of that figure.

† Those prisms which stand perpendicularly when resting on one of their bases, are called *right* prisms. Those which incline from the perpendicular, are called *oblique* prisms.

‡ By the use of the expression "quadrangular prism," it is apparent that two faces of the solid are chosen as bases. It may be asked, how are these to be distinguished? Those crystals which come within the definition of that general form, the parallelopiped (the character of which, is, that it is contained under three pairs of parallel planes,) with the exception of the Cube and Rhomboid present themselves to us, under an uniform appearance, as respects the modifications they undergo. These are ordered in a symmetrical manner, in relation to an imaginary

Fig. 28.



The lateral edges GG, Fig. 28. are always longer or shorter than the terminal ones BB. If these edges are equal, the form becomes a cube.

The right square Prism has an axis in four directions, similar to the Cube. It also has a line connecting the centres of the bases, called the *prismatic axis*.

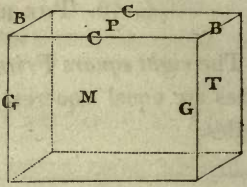
The individuals of this class may differ from each other in the comparative length of the edges G and B.

Scapolite, Apophyllite and Idocrase, may be mentioned as minerals which assume this form.

§. 41. The right rectangular Prism.

The right rectangular Prism is a quadrangular prism, whose bases are equal rectangles.

Fig. 29.



The lateral edges GG, Fig. 29. of this form are similar; but differ in length from the terminal edges CB, which are not equal. If G was equal to C or B, the form would be a right square Prism.

The same number of axes exist in this form, as in that of the right square Prism.

The individuals of this class will differ from each other in the comparative length of the three adjacent sides C, B, G.

The present form may be seen among the crystals of Anhydrite, Harmotone and Bournonite.

---

line connecting the centres of two opposite faces, and parallel to the edges of four other faces between them: this line ought therefore to be taken for a *prismatic axis*, the four faces for the *lateral planes*, and the other two for the *bases*.

When the prismatic axis is perpendicular to the bases of these solids, they are called right quadrangular prisms; when oblique, they are called oblique quadrangular prisms.

§. 42. The Right Rhombic Prism.

The right rhombic Prism is a quadrangular prism, whose bases are equal rhombs, and whose lateral planes are either equal squares, or equal rectangles.

Fig. 30.

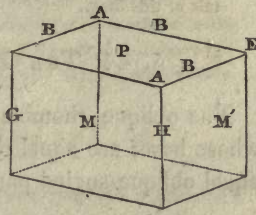


Fig. 30 is drawn with the greater diagonal of the bases horizontal. The solid angles at A are the *obtuse*, and those at E the *acute, solid angles*. The edge G and its opposite are the *acute*, and the edge H and its opposite the *obtuse, lateral edges*.

The right rhombic Prism, beside the prismatic axis, has *two greater* and *two lesser, axes*. The greater axes pass through the solid angles, which terminate the *acute edges* of the prism, as E E, and the lesser through those, which terminate the *obtuse edges* of the prism, as A A.

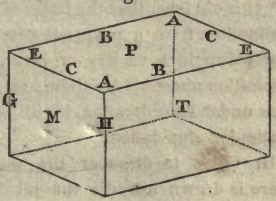
The individuals belonging to this class will differ from each other in the inclination of M on M′, or in the ratio of the edge H to the edge B.

The right rhombic Prism is one of the most frequent forms of crystals; examples are found in Andalusite, Sulphate of Barytes, Yenite, &c.

§. 43. The Right Oblique-angled Prism.

The right oblique-angled Prism is a quadrangular prism, whose bases are equal oblique-angled parallelograms.

Fig. 31.



The adjacent lateral faces, Fig. 31, are unequal. T is a rectangle; but M may be either a square or rectangle.

The angles and edges of this class of prisms are designated as those of the right rhombic Prism, (§. 42.) The solid angles at A are the *obtuse*, those

at E the *acute, solid angles;* the lateral edges at H the *obtuse,* those at G the *acute, lateral edges;* the edges B are the *greater,* and C the *lesser, terminal edges.*

The axes, also, are the same as in the right rhombic Prism.

The individuals belonging to this class will differ in the inclination of M on T, and in the relative lengths of the edges C, B, and H.

Sulphate of Lime, Heulandite, Wolfram, &c. are seen in crystals of this form.

§. 44. The Oblique Rhombic Prism.

The oblique rhombic Prism is a quadrangular prism, whose bases are equal rhombs, and whose lateral faces are equal oblique-angled parallelograms.

Fig. 32.

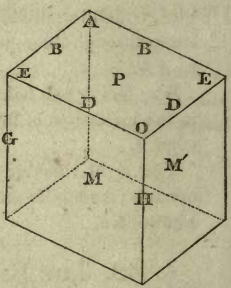


Fig. 32 is supposed to lean in the direction O, A, so that the terminal plane P forms an obtuse angle with the edge H. The planes M M′ may meet at an acute, or an obtuse angle. For the convenience of description, the solid angle at A will in either case be called the *acute solid angle,* that at O, *the obtuse solid angle;* and those at E, *the lateral solid angles.* The edges B, are called the *acute terminal edges,* and those at D, the *obtuse terminal edges.* The edge H and its opposite, are the *oblique edges of the prism,* and G and its opposite, the *lateral edges of the prism.**

* It is obvious, that the bases of a rhombic Prism, whatever may be its inclination from a perpendicular, are capable of being disposed upon that prism in a variety of ways. But as there are but two modes of disposition observed by them, among the crystals belonging to the class now under consideration, it will be sufficient to confine ourselves to their particular elucidation.

In order to discover the more readily their different positions, there is drawn towards the middle of the two oblique rhombic Prisms

The oblique rhombic Prism has, beside a prismatic axis, a *greater*, a *lesser*, and *two transverse*, *axes*. The greater axis is that which passes through the two *acute solid angles;* the lesser, that which passes through the *two obtuse solid angles*, and the *transverse*, those which pass through the *lateral solid angles*.

The planes M M′ may meet at an acute or an obtuse angle: in the former case, the prism is said to be *oblique from an acute edge*, and in the latter, *oblique from an obtuse edge*.

The individuals of this class will differ from each other in the inclination of M on M′, and in the ratio of the edge H to the edge D.

This is a frequent form among crystals. Laumonite, Pyroxene, Mica, &c., are examples.

§. 45. The Doubly Oblique Prism.

The doubly oblique Prism is a quadrangular prism, whose bases are equal oblique-angled parallelograms, and whose prismatic axis inclines from a perpendicular.

---

in Figs. 33 and 34, a plane or section perpendicular to their edges, or prismatic axes. The relations observable between the portions of the lateral edges of the prism situated above and below the perpendicular

Fig. 33.

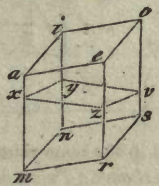
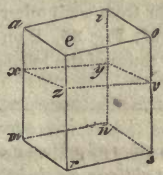
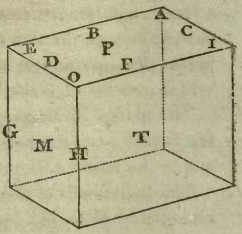


Fig. 34.



section $x\,y\,v\,z$, render apparent the different positions of the bases which we wish to indicate. An obtuse lateral edge is supposed to be in front, in both Figs. 33 and 34. In Fig. 33 the bases are so disposed that the obtuse edge $i\,y$ and $e\,z$ above the plane $x\,y\,v\,z$, or the corresponding ones below, $y\,n$ and $z\,r$, are equal to each other; while the acute edges $a\,x$ and $v\,o$, and the corresponding ones below the horizontal section $x\,y\,v\,z$, $x\,m$ and $v\,s$, are unequal. On the contrary, in Fig. 34, precisely the opposite takes place. It may be added, what indeed is sufficiently apparent, perhaps, that the base $a\,e\,o\,i$, Fig. 34, forms an equal angle with the planes $a\,m\,r\,e$ and $e\,r\,s\,o$.

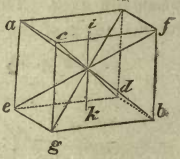
Fig. 35.



The lateral faces of this solid are generally oblique-angled parallelograms: two of them are always of this figure; the other two may be rhombs. The only equality subsisting among the faces is between each pair of opposite ones.*

The Figure 35 is supposed to be oblique in the direction O A, so that the terminal plane forms an obtuse angle with the edge H. Whatever may be the fact, for the purposes of description, the solid angle at A, will be called the *acute solid angle*, that at O, the *obtuse solid angle*, while those at E and I, will be called the *lateral solid angles*. The edges D and F, will be called the *obtuse terminal edges*, B and C the *acute terminal edges;* each of which will also be distinguished by their respective letters, as well in the case of edges as angles; H and its opposite the *obtuse lateral edges*, G and its opposite the *acute lateral edges*.

Fig. 36.



The doubly oblique Prism has four unequal axes passing through the pairs of opposite solid angles, as *a b*, Fig. 36, *c d*, *e f*, and *g h*; it has also the prismatic axis *i k*.

The individuals belonging to this class will differ from each other in the inclination of P on M, Fig. 35, P on T and M on T, and in the ratios of the edges D H and F.

---

* This class of prisms may be supposed to stand in the same relation to the *right oblique-angled Prisms*, that the *oblique rhombic Prism* does to the *right rhombic Prism:* we have only to suppose a right oblique-angled Prism to become oblique, and we have a correct idea of the doubly oblique Prism. As in the case of the oblique rhombic Prism, so also in this solid, we may conceive that the bases may be disposed as respects the prism in a variety of ways. Crystals themselves, however, present us with but two, which are different. In the first of these, they are disposed in such a manner *as not to make with any one of the lateral faces an angle equal to that which they form with the prismatic axis, or in such a way that the angles they form with two adjacent*

§. 46. The Rhomboid.*

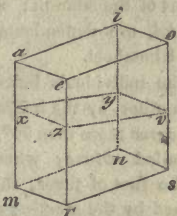
The Rhomboid is a solid, contained under six equal rhombic planes.

---

faces are unequal. Fig. 37, illustrates this kind of the doubly oblique Prism: the vertical projection is perpendicular, so that the transverse plane $xyvz$ is represented by a straight line. We observe in this instance, that those portions of the lateral edges which are above this plane are all unequal. The inclination of $iaeo$ upon the two lateral planes

Fig. 37.

Fig. 38.

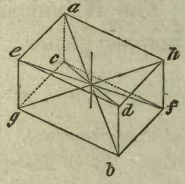


$ersо$ and $amre$ is different, and less in either case, than the inclination of that base to the prismatic axis. This form is found in the Axinite and in Sulphate of Copper. In the other case, arising out of the different method in which the bases are disposed, the position is such, that either of them, as $aeoi$, Fig. 38, forms with two opposite parallel lateral faces, $aerm$ and $iosn$, two angles, obtuse and acute, equal to those which it forms with the prismatic axis, or, what is the same thing, with the edges. We may recognise this position in the figure by the equality of the upper portions of the adjacent edges, which takes place *two and two*, $ax=ez$, $iy=ov$. In the particular instance represented by the figure, and which belongs to Feldspar, the section $xyvz$ of the prism is rectangular; then the face $ersо$, and its parallel, are perpendicular to the base.

* Weiss has proposed the name Rhombohedron for this solid, in analogy with Tetrahedron and Octahedron.

Its angular extremities are of two kinds; one of these consists of but two similar solid angles, and the line which connects them, as *ab* Fig. 39, is the perpendicular axis of the solid: when this is vertical, the Rhomboid is said to be *in position*. The lines *cd*, *gh*, *ef*, which connect the other similar solid angles, are called the *transverse axes* of the Rhomboid.*

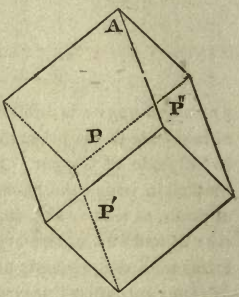
Fig. 39.



The two opposite solid angles, *a* and *b*, situated at the extremities of the perpendicular axis, are called the solid angles of the summit, or the *terminal solid angles:* the six remaining solid angles, and which are all equal, are termed the *lateral solid angles.* The edges *ah*, *ac* and *ae*, for the summit *a*, and the edges *bd*, *bf* and *bg*, for the opposite summit *b*, are called the *terminal edges*, or the edges of the summit; while the six other edges *de*, *eg*, *gc*, *cf*, *fh* and *hd*, are denominated the *lower edges*, or the *lateral edges* of the Rhomboid.

The individuals belonging to this class are distinguished from each other by the inclination of P on P′, Fig. 40. When P on P′ measures more than 90°, the Rhomboid is called *obtuse;* when less, *acute.* In the first of these, the summits are formed by the meeting of three obtuse plane angles, and the lateral solid angles are formed by the meeting of one obtuse and two acute plane angles. In the acute Rhomboid, the summits are formed of three acute plane angles, and the lateral solid angles are each formed by the meeting of two obtuse and one acute plane angle.†

Fig. 40.



The Rhomboid is one of the most frequent forms among crystals. Carbonate of Lime, Bitter Spar and Chabasie, are obvious examples.

---

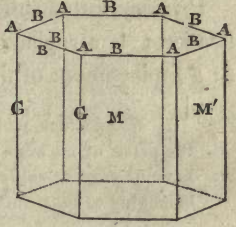
* The lines *ab* and *cd*, Fig. 39, have sometimes been called the *greater* and the *lesser axes* of the Rhomboid.

† It is apparent that the Cube, taking any one of its diagonals for the perpendicular axis, may be regarded as a Rhomboid, whose faces are square, and whose inclination to each other is 90° throughout. Now if we short-

§. 47. The Regular Hexagonal Prism.

The regular hexagonal Prism is a right prism whose bases are regular hexagons.

Fig. 41.



Any two of the adjacent lateral faces, as M, M′ Fig. 41, incline to each other under angles of 120°.

The hexagonal prism has as many axes as it has opposite solid angles, (viewed through the centre of the solid,) but the prismatic axis is the only one often used in the description of its modifications.

The individuals of this class can differ from one another only in the ratio of the edge G to the edge B.

The Emerald, Phosphate of Lime and Arseniate of Lead, may be instanced, as among minerals which possess this form.

CONSIDERATION OF THE CHANGES TO WHICH THE PRIMARY FORMS OF CRYSTALS ARE SUBJECT.

§. 48. Modifications of Primary Forms.

Primary forms are said to undergo modifications whenever they become more or less altered in their figure.

---

en this axis, the obtuse Rhomboid is immediately generated; and when the axis entirely disappears, the six faces fall into one plane of a hexagonal figure. On the other hand, by elongating the axis of the Cube, a series of acute Rhomboids is produced, which go on forming with indefinite variations, till that axis becomes a line of indefinite extent, when the solid vanishes. Thus the Rhomboid is limited in its variations, on one side by a *line*, and on the other by a *plane;* while in the intermediary state, it is a *solid*.

Change in dimensions can obviously have no effect upon the form: a Cube remains a Cube, so long as all its faces are squares. An alteration in the number, or relative position of the faces is requisite for inducing a change of form.

§. 49. Kinds of Modification.

Primary forms suffer alteration from two kinds of modification; 1. a replacement (or abstraction) of their edges: 2. a replacement of their angles.

1. When a face, which does not belong to a primary form, occupies the place of an edge or angle of that form, such a form is said to have its edge or angle *replaced.** The plane thus substituted, not belonging to the primary form, is denominated a *secondary plane.*

2. There are several varieties of modification confined to the edge. 1. An edge may be replaced by a single plane inclining equally upon the adjoining planes, as the lateral edge replaced by the plane *d*, Fig. 42. whose inclination to M and M′ is equal. In this case, the plane *d*, is often called a *tangent plane.* 2. The face substituted for an edge may incline upon the adjacent faces at unequal angles, as in Fig. 43. where the inclination of *f* on M′ is greater than *f* on M. 3. An edge may be replaced by two planes

Fig. 42.

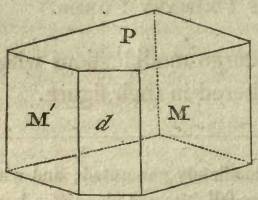
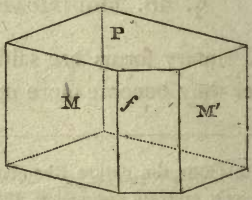


Fig. 43.



* It scarcely needs to be said, that this idea of replacement is not strictly speaking correct, since the edge or angle referred to never did exist, and of course could not have been replaced. The result, however, is precisely the same as respects the primary form, as though such a replacement had actually taken place.

inclining equally upon the adjacent planes, as the edge in Fig. 44, replaced by e and e'; e' inclines upon M′ at the same angle as e upon M. An edge replaced in this manner is sometimes said to be *bevilled*. 4. An edge may be replaced by two planes which incline unequally to their adjacent primary planes. Thus in Fig. 45, f forms with M′ a greater angle than e with M.

Fig. 44.

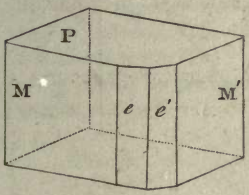
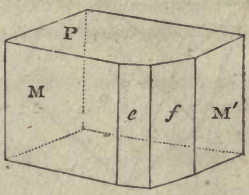


Fig. 45.



3. The variations among the modifications which take place at the angles are still more numerous. 1. An angle may be replaced by a single plane inclining equally to each one of the planes which formed the angle. Thus, in Fig. 46, the secondary plane a inclines to M′ under the same angle which it does to M or P. 2. An angle may be replaced by a plane inclining unequally to the adjacent primary planes. Thus, Fig. 47, b inclines to the three faces T, M,

Fig. 46.

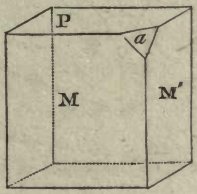
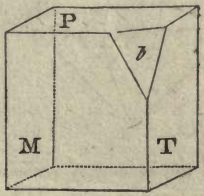


Fig. 47.



and P under different angles. 3. An angle may be replaced by two planes, as in Fig. 48. The relative position of these secondary planes to those of the primary is conveniently indicated by a reference to the direction of the edge formed by the intersection of the two new planes. In the present instance, it may be said to incline

upon the superior edges of the Rhomboid. In other cases, it may be parallel with the perpendicular axis of this solid, or it may incline upon the primary planes.

Fig. 48.

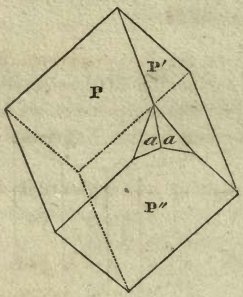
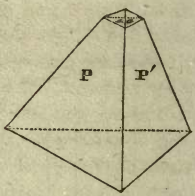


Fig. 49.



4. An angle may be replaced by three or more planes, according as it was made up of three or more plane angles, as in Figs. 49 and 50. The secondary planes may repose upon the primary planes as *a* upon P, Fig. 49, or

Fig. 50.

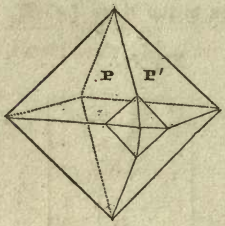
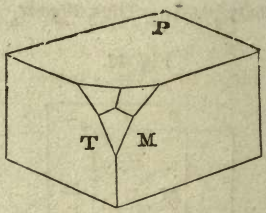


Fig. 51.



5. the secondary planes may repose upon the edges of the primary form, as in Fig 51.*

---

* Additional kinds of modification might have been described; but as those mentioned above are the most frequent among crystals, and are sufficient to render the subject perfectly intelligible, it was not thought necessary to detain the student with the enumeration of others.

§. 50. Disposition of Secondary planes regulated by Symmetrical Laws.

The same modification generally takes place upon every similar edge or angle of a primary form.

In the Tetrahedron, the Cube, and the regular Octahedron, (forms, among whose edges and angles there exists the most perfect similarity,) when one edge or angle is subject to a replacement, we find all similarly affected. The following figures, representing actual crystals, illustrate this idea.

Fig. 52 exhibits the Tetrahedron, with its solid angles replaced by tangent planes.

Fig. 52.

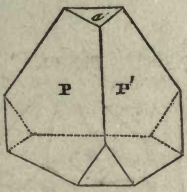


Fig. 53.

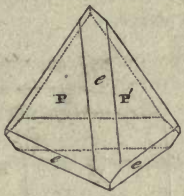


Fig. 54.

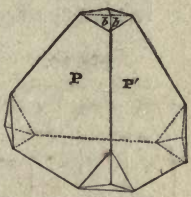


Fig. 53, the same, with its edges replaced by tangent planes.

Fig. 54, the same, with its angles replaced by three planes, resting on the primary planes.

Fig. 55.

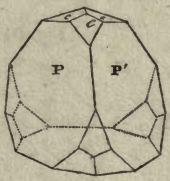


Fig. 56.

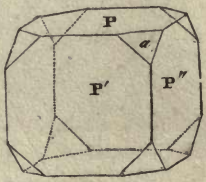


Fig. 55, the same, with its angles replaced by three planes, resting on the primary edges.

Fig. 56, exhibits the Cube with its angles replaced by tangent planes.

Fig. 57, the same, with its edges replaced by tangent planes.
Fig. 58, the same, with its edges replaced by two planes.

Fig. 57.

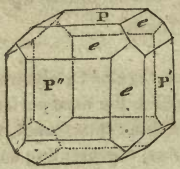


Fig. 58.

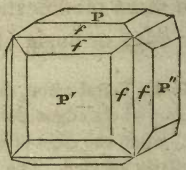


Fig. 59, the same, with its solid angles replaced by three planes, resting on the primary planes.
Fig. 60, the same, with its solid angles replaced by six planes.
Fig. 61, represents the regular Octahedron, with its solid angles replaced by tangent planes.

Fig. 59.

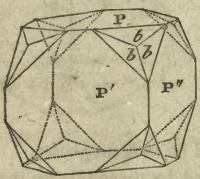


Fig. 60.

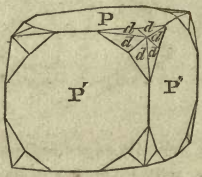


Fig. 61.

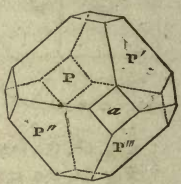


Fig. 62, the same, with its edges replaced by tangent planes.
Fig. 63, the same, with its edges replaced by two planes.

Fig. 62.

Fig. 63.

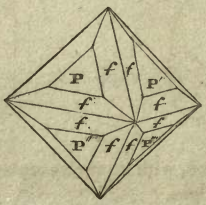


Fig. 64.

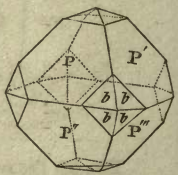


Fig. 64, the same, with its solid angles replaced by four planes, resting on the primary planes.

The rhombic Dodecahedron (§. 36.) has all its edges similar, and situated at an equal distance from the centre; but its angles are of two kinds, six formed of four plane angles, and eight of three plane angles. Agreeably to our proposition then, all its edges will undergo a similar modification at once, while only a part of its solid angles will be subject to the same replacement. Accordingly,

Fig. 65, exhibits the rhombic Dodecahedron, with its edges replaced by tangent planes.

Fig. 66, the same, with its edges replaced by two planes.

Fig. 65.

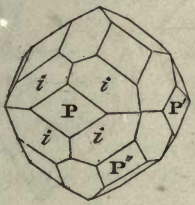


Fig. 66.

Fig. 67, the same, with its obtuse solid angles replaced by tangent planes.

Fig. 68, the same, with its acute solid angles replaced by tangent planes.

Fig. 67.

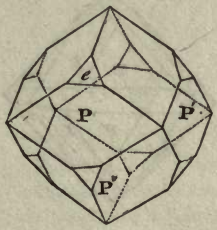
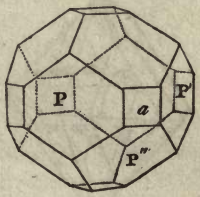


Fig. 68.



The similar edges and angles of the different Octahedrons have been sufficiently described in our account of these solids (§. 35, 37, 38, 39); the modifications they undergo are regulated by this similarity, as may be seen in the examples here given.

Fig. 69, represents the Octahedron with a square base, having its pyramidal edges replaced by tangent planes.

Fig. 70, the same, having the edges of the base replaced by tangent planes.

Fig. 71, the same, with the solid angles of the base replaced by tangent planes.

Fig. 69.

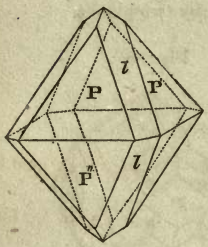


Fig. 70.

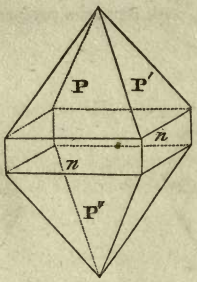


Fig. 71.

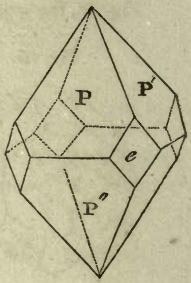


Fig. 72, the same, having its pyramidal edges replaced by two planes.

Fig. 73, represents the Octahedron with a rectangular base, having the edges of the pyramids replaced by single planes.

Fig. 72.

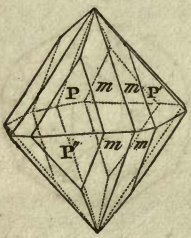


Fig. 73.

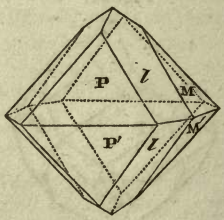


Fig. 74, represents the Octahedron with a rhombic base, having the edges of the base replaced by tangent planes.

Fig. 75, the same, with its terminal solid angles replaced by tangent planes.

Fig. 74.

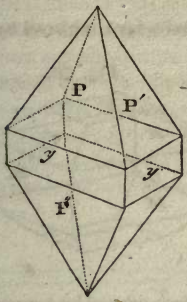


Fig. 75.

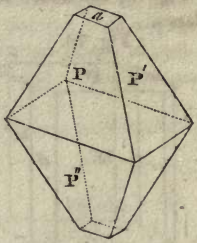


Fig. 76, the same, with its obtuse lateral solid angles replaced by tangent planes.

Fig. 77, the same, with its terminal solid angles replaced by four planes, reposing upon the primary planes.

Fig. 76.

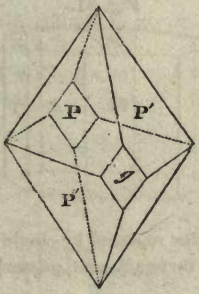
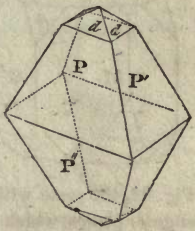


Fig. 77.



In the varieties of the *quadrangular prism*, the lateral edges hold a different position from the terminal edges; but sometimes the lateral edges are all similar, at others, only two and two. The same holds with respect to the terminal edges. The solid angles may also be either all identical in position, or they may occupy two different positions.

In the *right square Prism*, the four lateral edges are similar; the four terminal edges are so also, as well as the solid angles. The modifications correspond to this identity, as may be judged of from the following examples.

Fig. 78, exhibits the right square Prism with its lateral edges replaced by tangent planes.

Fig. 79, the same, with the terminal edges replaced by tangent planes.

Fig. 78.

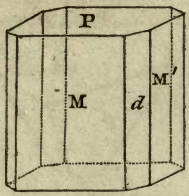


Fig. 79.

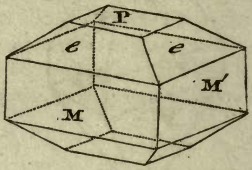


Fig. 80, the same, with the solid angles replaced by tangent planes.

In the *right rectangular Prism* the lateral edges are similar, likewise the solid angles; but the adjoining terminal edges are dissimilar. According to the law of symmetry, therefore, the modifications take place in the following manner.

Fig. 81 presents the right rectangular Prism with its lateral edges replaced by tangent planes.

Fig. 80.

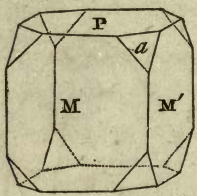


Fig. 81.

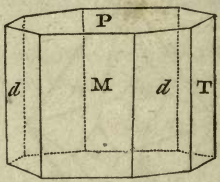


Fig. 82, the same with its solid angles replaced by single *scalene* triangular planes, which incline on the three adjacent, primary planes at unequal angles.

Fig. 83, the same, with the lesser terminal edges replaced by single planes.

Fig. 82.

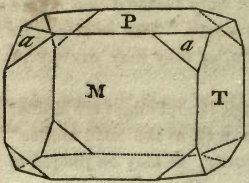


Fig. 83.

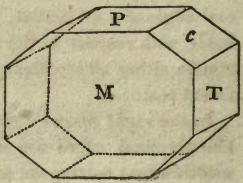


Fig. 84, the same, with the greater terminal edges replaced by single planes.

In the right rhombic Prism, the terminal edges are similar; but the two opposite, obtuse lateral edges, and the solid angles which terminate them, are different from the acute lateral edges, and the corresponding solid angles. The modifications of this form are therefore in conformity with these relations.

Fig. 85 represents the right rhombic Prism, with its obtuse lateral edges replaced by tangent planes.

Fig. 84.

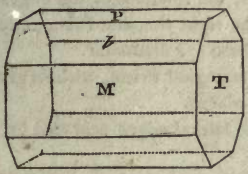


Fig. 85.

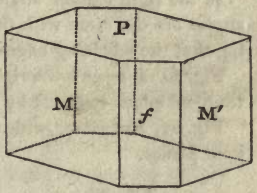


Fig. 86, the same, with its obtuse lateral edges replaced by two planes.

Fig. 87, the same, with its acute lateral edges replaced by two planes.

Fig. 86.

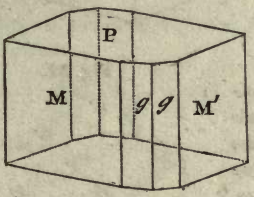


Fig. 87.

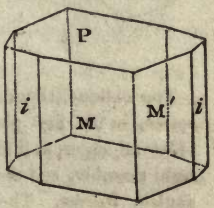


Fig. 88, the same, with its obtuse solid angles replaced by single planes, which intersect the terminal plane parallel to its greater diagonal.

Fig. 89, the same, with its acute solid angles replaced by single planes, which intersect the terminal plane parallel to its shorter diagonal.

Fig. 88.

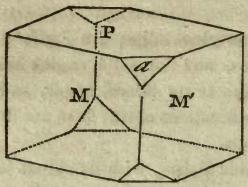
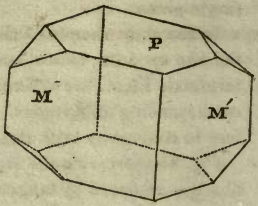


Fig. 89.



In the right oblique angled Prism, the relations of the edges and angles are the same with those of the right rhombic Prism, excepting that the adjoining edges of the base are dissimilar.

Fig. 90 represents the right oblique angled Prism, with its greater terminal edges replaced by tangent planes.

Fig. 91, the same, with the acute lateral edges replaced by tangent planes.

Fig. 90.

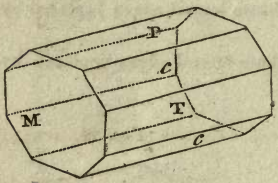
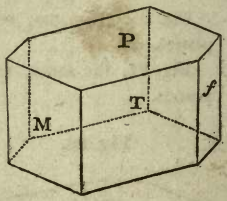
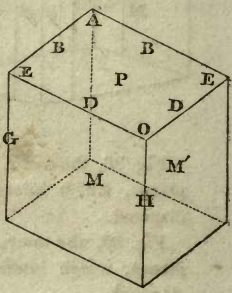


Fig. 91.



The oblique rhombic Prism possesses, in the first place, two kinds of lateral edges, as in the cases of the right rhombic, and the right oblique angled, Prisms. The solid angles, Fig. 92, E and E are equal; but the solid angles A and O are different from the first, and from one another; consequently, the edges B B of the base, similarly situated, differ in position from the edges D D.

Fig. 92.



From the foregoing, it necessarily results that the modifications of the terminations, in order to be symmetrical, must always take place in a different manner upon two halves of this solid, supposing the division to be made by a vertical plane passing through the edge G and its opposite. The following examples, drawn also from actual crystals, are in exact coincidence with these relations.

Fig. 93 represents the oblique rhombic Prism, with the oblique edges of the prism replaced by tangent planes.

Fig. 94, the same, with the lateral edges of the prism replaced by tangent planes.

Fig. 93.

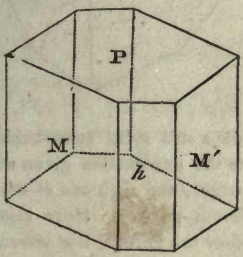


Fig. 94.

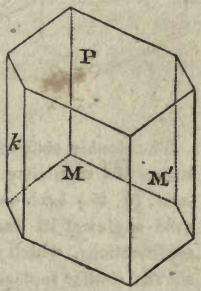


Fig. 95, the same, with the obtuse terminal edges replaced by single planes.

Fig. 96, the same, with the acute terminal edges replaced by single planes.

Fig. 95.

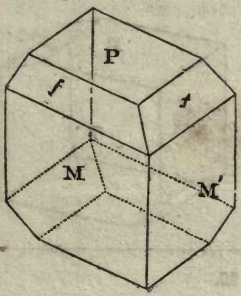


Fig. 96.

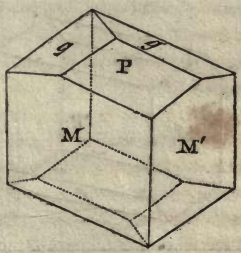


Fig. 97, the same, with the acute solid angles replaced by single planes.

Fig. 98, the same, with lateral solid angles replaced by single planes.

Fig. 97.

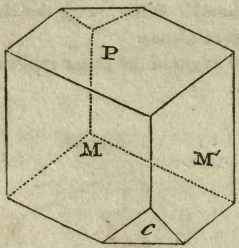
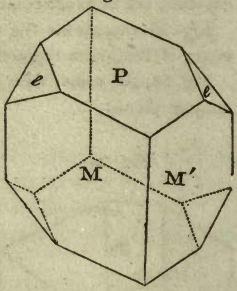


Fig. 98.



The doubly oblique Prism presents a still more remarkable instance of irregularity. According to the explanation given of this solid, (§. 45.) each one of the four edges, and each one of the four solid angles of its base, is in a different position. Here also the modifications, which take place, follow the general law announced above; similar replacements occurring only upon similar edges or angles.

Fig. 99 represents the doubly oblique Prism, with its acute terminal edges B,* replaced by single planes.

Fig. 100, the same, with its acute terminal edges C replaced by single planes.

Fig. 99.

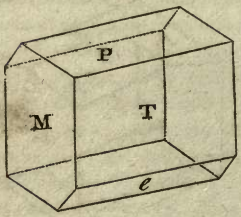
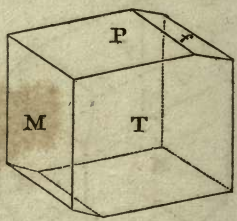


Fig. 100.



* See Fig. 35.

Fig. 101, the same, with its obtuse terminal edges D replaced by single planes.

Fig. 102, the same, with its obtuse terminal edges F replaced by single planes.

Fig. 101.

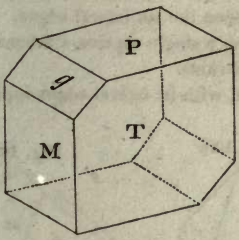


Fig. 102.

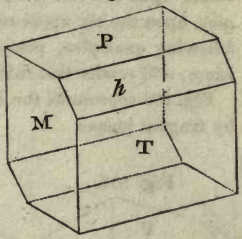


Fig. 103, the same, with the oblique edges of the prism replaced by single planes.

Fig. 104, the same, with the lateral edges of the prism replaced by single planes.

Fig. 103.

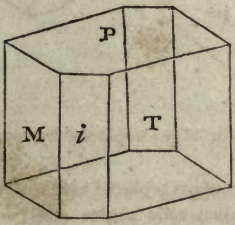


Fig. 104.

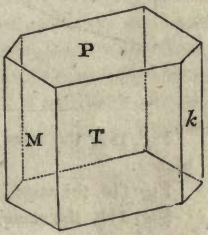


Fig. 105, the same, with obtuse solid angles O replaced by single planes.

Fig. 106, the same, with acute solid angles A replaced by single planes.

Fig. 105.

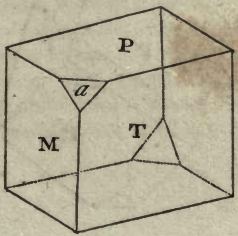


Fig. 106.

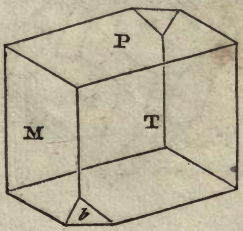


Fig. 107, the same, with the lateral solid angles E replaced by single planes.

According to the geometrical properties of the Rhomboid, as they have been explained, (§. 46.) we must look for similar modifications either upon the two terminal solid angles, upon the six lateral angles, upon the six upper edges, or upon the six lateral edges. The following examples, principally from a single species, Carbonate of Lime, will render this sufficiently obvious.

Fig. 108 represents the Rhomboid, with its lateral edges replaced by tangent planes.

Fig. 107.

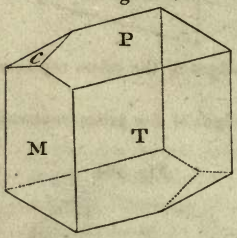


Fig. 108.

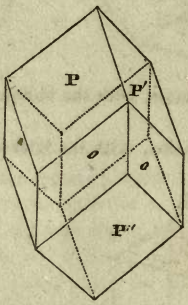


Fig. 109.

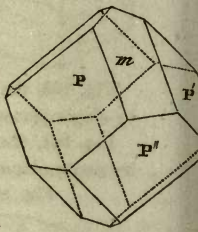


Fig. 109, the same, with its superior edges replaced by tangent planes.

Fig. 110, the same, with its superior edges replaced by two planes.

Fig. 111, the same, with its terminal solid angles replaced by tangent planes.

Fig. 110.

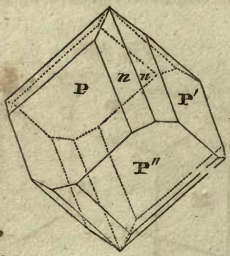


Fig. 111.

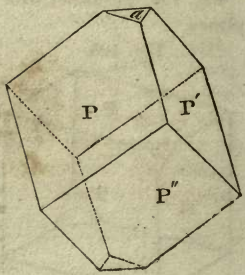


Fig. 112, the same, with its lateral solid angles replaced by single planes, parallel to the perpendicular axis of the Rhomboid.

Fig. 113, the same, with its lateral solid angles replaced by two planes, meeting at an edge which is parallel to the perpendicular axis of the Rhomboid.

Fig. 112.

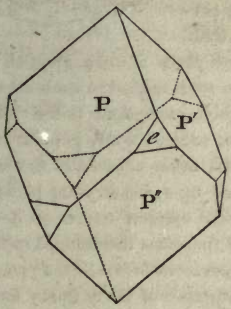
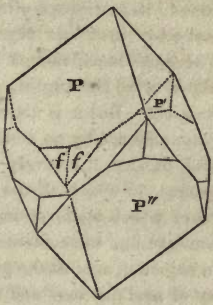
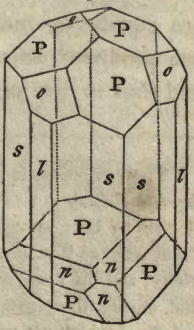


Fig. 113.



The relative disposition of the different parts of the regular hexagonal Prism is too easy to conceive of, to require a recapitulation of them here; and it will suffice to say, without instancing any examples, that all the terminal edges are modified together, and in a similar manner; the same is also true of the lateral edges and of all the solid angles.

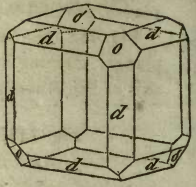
Fig. 114.



The law whose application has just been considered cannot be said to be universal. The Tourmaline, as well as Boracite, present us with two very remarkable exceptions. In the first, the primary form is a Rhomboid. Yet it is found, that the three edges formed by the meeting of the three faces P, P, P at each extremity of the six sided prism *s*, *s*, *s*, Fig. 114, are replaced only at one end by the tangent planes *n*, *n*, *n*. It is noticed also, that only the alternate three of the lateral solid angles are modified, the remaining three being unal-

tered. In the second, we see a Cube whose edges are indeed all similarly replaced, but only the half of whose angles are thus affected; viz. one of the two which are opposite each other, at the extremities of the same axis, Fig. 115.*

Fig. 115.



In addition to the two cases just mentioned, it is necessary to add, that in several other instances crystals are met with, where the modifications have not taken place at once upon all the edges, or all the angles, whose position with regard to each other is identical. But it is noticeable that such exceptions to the law of symmetry are by no means constant, or subject to any general rule. And, besides, it is rarely difficult to find other crystals of the same species, in which all the faces required by symmetry are present; a fact which tends strongly to justify the opinion that these deviations are due to accidental causes, and therefore insufficient to form an objection against the principle of agreement between the symmetry of modifications and that of the structure of the primary forms.

§. 51. Passage of one Form into another.

The proportions existing between the extent of the primary and secondary planes are very variable. Sometimes, the change effected by the modification is so small as scarcely to be perceptible; at others, the new planes are equally extended with the primary; and, again, they are produced so as wholly to obliterate the original faces, and thus to give origin to new forms.

---

* The exceptions in the instances mentioned above were supposed by the Abbé Haüy to be dependent upon electricity. These crystals are electric by heat, and give two kinds of electricity in two opposite points. From whence it is imagined that this anomaly of form is a result of electricity, and the conjecture appears to be strengthened by the observation that among the crystals of Sphene, there are those which are electric and those which are non-electric; in the first case, the two summits are different, in the last, they are similar.

The idea here intended to be expressed will become more intelligible by a reference to the annexed figures. Fig. 116 represents a regular hexagonal Prism, with its terminal edges replaced by tangent planes, the new planes being but slightly produced. Fig. 117, the same, in which the new planes are still farther extended; and Fig. 118, in which the hexagonal summits have given place to mere points, and the sides of the prism entirely disappeared,—the original solid having become a Dodecahedron with triangular faces.

Fig. 116.

Fig. 117.

Fig. 118.

The foregoing instance may serve to explain what is understood in crystallography, when it is said *one form passes into another*. The latter solid is said to be *derived* from the first.

It is requisite that the student should be made acquainted with some of those forms, which may thus be derived from others according to the laws of symmetry, since these derivations will explain that multiplicity of forms under which the crystals of the same species sometimes occur. (§. 30.)

It has been seen that, in the regular Tetrahedron, the Cube, and the regular Octahedron, all the faces in each are equal and similarly situated; and that the same is true as respects their solid angles and edges. A similar identity has been ascribed to the faces and edges of the rhombic Dodecahedron, and, also, to its six solid angles formed from the meeting of four plane angles, and to its eight solid angles of three plane angles.

The similar parts of one of these solids would be modified in a similar manner, if we suppose that its similar edges or similar solid angles are replaced by tangent planes; and if we suppose the secondary planes to be so extended as to extinguish those of the primary, it is obvious a new polyhedral solid must appear, contained under faces amounting in number to the edges or angles replaced in the original form.

If now we collect the number of similar parts, which are similarly situated, as respects the centre in each of the above mentioned forms, we have the following result.

Tetrahedron,	6 edges,	4 angles,	4 faces.	
Cube,	6 faces,	8 angles,	12 edges.	
Octahedron,	6 angles,	8 faces,	12 edges.	
Dodecahedron,	6 angles of four plane angles,	8 angles of three plane angles,	12 faces,	24 edges.

The faces of either of these solids must necessarily be produced through the replacement, by tangent planes, (these planes being continued down to the obliteration of the primary,) of the edges or angles of either of the other solids, provided those edges or angles equal the number of its faces.

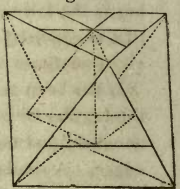
For example, the twelve faces of the Dodecahedron may be derived either from the tangent replacement of the twelve edges of the regular Octahedron, (Fig. 62,) or from a similar replacement of the twelve edges of the Cube, (Fig. 57.)*

The eight faces of the Octahedron may be the result either of the tangent replacement of the eight angles of the Cube, (Fig. 56,) or of the eight obtuse solid angles of the Dodecahedron, (Fig. 68.)

The six faces of the Cube may be derived from the truncation of the six edges of the Tetrahedron, (Fig. 53,) or from the six acute solid angles of the Dodecahedron, (Fig. 67.)

The Tetrahedron cannot be derived in the same manner with the other solids; but may result from the Octahedron, by the suppression of half of its eight faces; or, in other words, by the enlargement of one of the two parallel faces, until the other is made to disappear. Fig. 119 shews the planes of the Tetrahedron in the position it occupied in the Octahedron.†

Fig. 119.

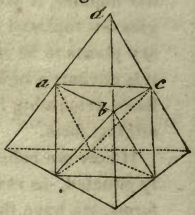


---

* The student in crystallography who has not attended to the connections subsisting between the different solids, by which one form may be transformed into another, is recommended to verify some of the changes here described, by shaving pieces of wax, or some other soft substance, with a knife.

† The Tetrahedron thus derived, passes again to the Octahedron, by the truncation of its solid angles, as seen in Fig. 120.

Fig. 120.



The Tetrahedron may be derived from the Cube and from the rhombic Dodecahedron, by means of the tangent replacement of half of the similar parts of these solids which exist to the number of eight.

Many species of minerals present crystals which exemplify this passage of one form into another, according to the symmetrical modifications just noticed. Thus, Fluor and Sulphuret of Silver are crystallized under the different forms of the Cube, the regular Octahedron and the rhombic Dodecahedron; the Diamond and Red Oxide of Copper under the same; and Blende under the Octahedron, the Dodecahedron and the Tetrahedron.

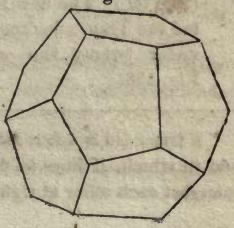
In the transitions into each other of the solids just enumerated, in consequence of the symmetrical modifications they undergo, we have seen that they were the result of tangent replacements. We will now notice some of the new forms produced upon these forms by the operation of other modifications.

It has been seen that the truncation of all the edges of the Cube by tangent planes would result in the rhombic Dodecahedron. If, however, the edges be replaced by single planes, inclining at unequal angles on the adjacent primary planes, a series of Dodecahedrons with pentagonal faces would be the result.* Fig. 121 illustrates this transition of the Cube into the Dodecahedron with pentagonal faces: the new planes *k*, are not produced so as completely to obliterate the faces P of the original Cube.

Fig. 121.

The replacement of the edges of the Cube by two planes produces a series of four sided pyramids on the planes of the Cube. Fig. 123 shows this passage of the Cube into a form contained under twenty four planes. The primary faces are represented, in the figure, as nearly extinguished. The new form produced in this way,

Fig. 122.



* There is only one of the series, Fig. 122, known to exist among crystals.

when complete, is bounded by twenty four isosceles triangular planes, and is represented in Fig. 124.

Fig. 123.

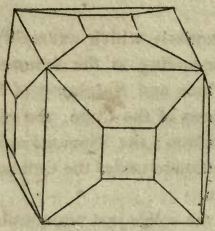
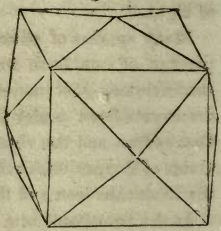


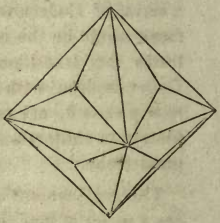
Fig. 124.



It is produced from the regular Octahedron, also, from the modification of its solid angles by four planes resting on the primary edges; also, from the rhombic Dodecahedron by the replacement of its acute solid angles by four planes resting on the primary planes.

The replacement of the edges of the Octahedron by two planes, leads to the erection of a trihedral pyramid on each primary plane, as represented in Fig. 63. When the primary planes P become extinct, we have another isosceles triangular solid, under twenty four faces, as in Fig. 125.

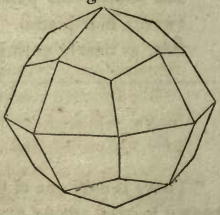
Fig. 125.



This form is produced in like manner from the Cube, by the replacement of its solid angles by three planes resting on the edges of the Cube; and from the rhombic Dodecahedron, by the modification of its obtuse solid angles by three planes resting on the primary planes.

Another new form, still more frequently met with among crystals, is produced from the Cube, by the replacement of its solid angles by three planes resting on the primary planes. (Fig. 59.) The new form is denominated the Trapezohedron, and is contained under twenty four equal trapezoids.* Fig. 126.

Fig. 126.

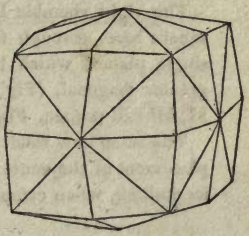


* A trapezoid is a four sided figure whose opposite edges are unequal, and in which, if lines be drawn through the opposite angles, they will intersect each other at right angles.

It flows also from the regular Octahedron, through the replacement of its solid angles by four planes resting on the primary planes, and from the rhombic Dodecahedron through the tangent replacement of its edges. (Fig. 65.)*

If the Cube have its solid angles replaced by six planes, (Fig. 60,) the new figure will be contained under forty eight triangular planes. Fig. 127.

Fig. 127.



The replacement of the solid angles of the regular Octahedron by eight planes, leads to the same result; as likewise the replacement of the edges of the rhombic Dodecahedron by two planes. (Fig. 66.)

The foregoing derivations are abundantly exemplified among the crystals of minerals. The passage of the Cube into the pentagonal Dodecahedron occurs in Iron Pyrites and Grey Cobalt; the derivation of the twenty four sided isosceles triangular form, is seen in the crystals of the Diamond and Sulphuret of Iron; the Trapezohedron flows from the Dodecahedron in Garnet and from the Cube in Analcime; and the last mentioned solid under forty eight triangular planes, occurs among the crystals of Fluor.

The Octahedron with a square base passes into another Octahedron with a square base, by the replacement of the edges of the pyramids by tangent planes, (Fig. 69); the new octahedron is more obtuse than the primary. This modification occurs in Sphene. The tangent replacement of the edges, or of the angles of the base, (Figs. 70, 71,) give rise to the right square Prism; a result of frequent occurrence in Zircon crystals.

The Octahedron with a rectangular base is capable of giving rise to an Octahedron with a rhombic base, by the replacement of the edges of the pyramids by single planes. (Fig. 73.)

The Octahedron with a rhombic base passes into the rhombic prism, by the replacement of the edges of the base by tangent planes, (Fig. 74.) We have this modification in Sulphur.

The right square Prism, according to the symmetry of its modifications, produces, either another similar right square Prism by the

---

* This, though an instance of tangent modification, was deferred to be mentioned here.

tangent replacement of its lateral edges, or an octahedron by the truncation of its terminal edges or solid angles.

The right rectangular Prism will afford a rhombic prism by the replacement of its lateral edges by single planes, or an Octahedron with a rectangular base, by the truncation of its terminal edges.

The right rhombic Prism may pass into an Octahedron with a square base, through the replacement of its obtuse solid angles by single planes, which intersect the terminal plane parallel to its greater diagonal, (Fig. 88); portions of the primary lateral planes M, M′ still remain. Fig. 128.

The same new solid, Fig. 129, may also result from a similar replacement of the acute solid angles, (Fig. 89); but it is reversed in its position, when compared with the former one.

Fig. 128.

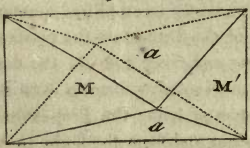
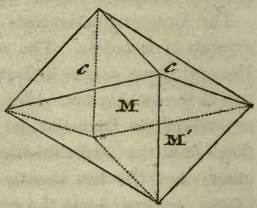


Fig. 129.



It passes into Octahedrons with rhombic bases, through the replacement of its terminal edges by single planes.

Crystals of Heavy Spar illustrate these transitions.

The right oblique angled Prism does not give rise to either of the other primary forms, in the modifications it undergoes among crystals.

The oblique rhombic Prism gives origin to an oblique, six sided prism, by the tangent replacement of the acute edges of the prism, (Fig. 95,) as in the crystals of Mica.

The doubly oblique Prism does not pass by its modifications into either of the geometrical solids.

The regular six sided Prism, as has been already noticed, passes into the Dodecahedron with isosceles triangular faces, (Fig. 118,) by the replacement of its terminal edges by similar planes. (Fig. 116.)

The Rhomboid passes into a Rhomboid more obtuse than the primary, when its superior edges are replaced by tangent planes. (Fig. 109.)

The replacement of the lateral edges, (Fig. 108,) or angles, Fig. 130, by tangent planes, produces a regular six sided Prism.

That of its lateral edges, or superior edges, (Fig. 110,) by two planes, results in a Dodecahedron with scalene triangular faces, Fig. 131.

Fig. 130.

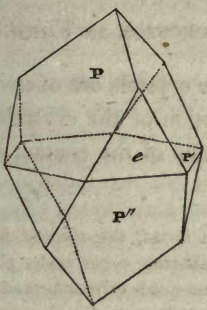


Fig. 131.

The second Rhomboid of a mineral, or the first new one, may itself suffer the same modification as the primary, and thus produce another, still more obtuse. Carbonate of Lime presents us, in this way, with four distinct Rhomboids.

Though it may appear to the student hardly possible that the changes to which the primary forms are subject, are as numerous as would appear from the instances enumerated, yet he will find them in reality to be much more so, as his knowledge of crystals becomes extended. Still, those which have just been pointed out, are among those most frequently met with, and the most easily understood by the young student.

It will now be seen, that it is natural that most crystallized minerals should present themselves under several distinct forms, (§. 30,) since this variation of form is a necessary result of the symmetry of structure in one primitive form, and of the laws no less symmetrical to which these modifications are subject. At the same time, it must be recollected, that the number and the nature of these various forms of the same substance are necessarily limited, and dependant upon the structure of one fundamental form. (§. 31.)

OF THE IMPERFECTIONS OF CRYSTALS IN RESPECT TO THEIR FORM.

§. 52. Kinds of Imperfection in Form.

The irregularities noticeable in crystals are of two kinds; and originate either in the formation of the crystals themselves, or they are the consequence of the contact of these with other minerals.

In the foregoing considerations of forms, the student may have been led to imagine that crystals uniformly occur under planes of a constant figure and extent. He now needs to be informed that perfect regularity, in these respects, is rarely to be found. At the same time, the deviations from it, (as will presently be seen,) are of such a kind as to occasion only a slight inconvenience in ascertaining their relations, and too unimportant to require that they should be treated of, except under the idea of perfect regularity.

In those cases where crystals are possessed of the irregularity alluded to, and where the circumstances under which they are found do not indicate any external disturbance of their forms, we are naturally led to suppose that the deviations it presents are founded upon the formation of the crystals themselves. On the other hand, where crystals occur in contact with each other and with other minerals, or where they have been subjected to other accidents, their irregularities are referrible to these causes. The former imperfections are the most important. The latter will be more particularly treated of under compound minerals. At present, it is only necessary to examine in what shape an individual will appear, which is prevented from assuming its regular form by some external obstacle.

§. 53. Irregularities depending upon the Formation of the Individuals themselves.

Deviations from regularity in crystalline forms appear either in their size and figure, or in the physical quality of their faces.

Thus, hexagonal crystals of Beryl frequently have their alternate lateral faces so enlarged as to give them the appearance of triangular prisms. The faces of a cubical crystal of Galena very often are not squares. Dodecahedral crystals of Garnet are sometimes elongated in the direction of one of the lesser axes, by which means it becomes apparently a regular six sided prism, surmounted by trihedral summits, &c.

The same thing takes place with regard to the modifications of simple forms. Some of the faces of the modification are irregularly increased, whilst corresponding faces belonging to the same forms are diminished, till they almost or wholly disappear. This remark is exemplified in the crystals of Quartz.

In addition to the above irregularity, we have, in the crystals of a few species, slight curvatures in the faces. If these curvatures take place in simple forms, it generally affects all the faces at once, as in the crystals of Diamond and Fluor. If it take place upon modifying planes, it is confined to those which are similar, as in certain crystals of Gypsum.

Notwithstanding all the irregularities arising out of the disproportionate extension of similar faces, the inclination of these faces to each other is invariably constant, and precisely the same as though their dimensions were exactly similar, and the form were possessed of the highest degree of perfection. For example, in Figures 132 and 133, representing crystals of Quartz, any two planes which may be selected in Fig. 132 incline to each other under the same angle as the two similarly situated planes in Fig. 133.

Fig. 132.

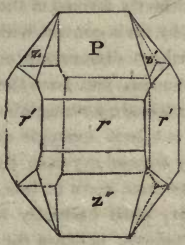


Fig. 133.

This remarkable fact was first ascertained and demonstrated by Romé de l'Isle, and is at the foundation of the application of crystallography to the discrimination of minerals.

§. 54. Irregularities from contact with other Individuals.

There are two sorts of contact by which the regularity of crystals is affected; viz. 1. contact on all sides, 2. contact only by some of their parts.

Crystals surrounded and inclosed by the solid mass in which they are found, or in which they have been formed, are in contact with this mass on all sides. This mass may either be of the same substance with the crystals, or it may be otherwise. In the first instance, the regularity of the form is scarcely ever perceptible. One individual prevents the other individual, by their contact, from assuming that regular form, which under other circumstances, is peculiar to it; and we see individuals in these cases assuming their regular shape only, when some cavity or empty space occurs in the mass, which enables them to emerge from contact with other individuals.

If the mass, which surrounds a crystal, is not of the same nature with the crystal, the regularity of the latter is not so liable to be impaired. A crystal, under such circumstances, is said to be *imbedded;* and when disengaged from its bed, is termed a *loose crystal.* Crystals of this kind may be taken out of the mass which surrounds them, and if they do not cohere with any particles of the mass, a smooth print of their form will remain. Loose crystals, if not imperfect in some other way, may be considered as the most perfect productions of inorganic nature. Such crystals, however, are comparatively rare. More commonly, they are imperfectly formed of themselves, or they have been rendered imperfect by their contact with the surrounding mass. Those individuals, whose dimensions are nearly equal, appear as rounded or angular masses, and bear the name of *grains* or *angular masses*, both of which are nothing else but imperfectly formed crystals. Pargasite is a good example of crystals of this sort. Besides these imperfectly formed crystals, there exist a great many others, which likewise assume, more or less, a globular or angular shape. These, however, must carefully be distinguished from real grains and angular masses, because they are not simple but compound minerals. (§. 15.)

Crystals which are formed in an empty space, and adhere only with some of their parts to the support, which in most cases is different from the mass of crystals, are termed *implanted* crystals.

We say crystals which are formed in an *empty space*,—this is not necessary provided the mineral into which the crystal shoots from its support is different from the crystals themselves, and from the support generally, and is capable of being detached from the crystals so as to leave them free except in their attachment to the supporting mass with which their connexion is peculiar, inasmuch as they cannot be removed from it so as to leave behind a print of their form; they can only be separated from the support by breaking. Of course, implanted crystals are always incomplete, because those parts are wanting in which the crystals are attached to the supporting mass.

Other imperfections to which crystals are liable from external sources, are such as arise from disturbances in the rocks which contain them, in consequence of which they are contorted or have been subject to *slips;* or from their having been acted upon by heat, and thus become rounded on some of their edges and angles.

Implanted crystals as well as those which are irregular from the undue enlargement of some of their planes, or which have been broken by accident, are completed according to the rules of symmetry in order to fit them for the purpose of crystallographic consideration. For example, Quartz ordinarily occurs in regular six sided Prisms, terminated at each extremity by six-sided pyramids. But when these crystals occur implanted, they are usually attached to the supporting mineral by one end of the prism without the intervention of the pyramid; we therefore complete this termination, by supposing it equal and similar to that which has been observed. Sometimes only one pyramid is observable among implanted crystals of Quartz: in such a case, we have to imagine the prism and other pyramids conformably to the rules of symmetry; for we can never be entitled to assume or consider such crystals as simple pyramids, because such forms do not exist among minerals, nor are they capable of being obtained by any process of derivation.

A few cases however exist, in which it is necessary to allow of exceptions to this general rule. Such are the crystals whose opposite solid angles possess a different configuration, and which present differences in their electric action when heated, §. 50. p. 47.

§ 55. System of Crystallization.

The assemblage of forms derivable from one primary form, is termed a system of crystallization.

All crystals which have hitherto been discovered, are capable of being referred to some one of the primary forms which have been described. Should a crystal be hereafter discovered, which agreeable to the symmetrical laws of derivation could not be referred to one of these, a new primary form would be necessary, and it would constitute a member of a new system of crystallization. In each of these systems it is customary to consider all those forms as belonging to it, which are geometrically derivable from it, although they should not as yet have been observed among minerals.

In the system of crystallization, the dimensions are not fixed, except indeed where it is so from the nature of the fundamental form as in the regular Octahedron, the Cube, the Tetrahedron and the rhombic Dodecahedron. Any number of prisms, whatever may be their height, will belong to the same system of crystallization; any number of Rhomboids, whether acute or obtuse, will be included under the same system, &c.

The system of crystallization derived from the different primary forms are termed the systems of those forms respectively: thus the *system of crystallization belonging to the Cube*, &c.

§. 56. Series of Crystallization.

The primary form being supposed to possess determined dimensions, the assemblage of derived forms becomes a series of crystallization.

Among the primary forms the Tetrahedron, the Cube, the regular Octahedron and the rhombic Dodecahedron possess invariable dimensions; accordingly they will each possess but one series of crystallization, while the other systems of crystallization as they possess variable dimensions will comprehend an unlimited number of such series, or as many as there may be differences in the dimensions of their primary forms. Thus in the system of crystallization belonging to the right square Prism, there may be any number of series of crystallization according as these prisms may be conceived to differ from each other in the relation of their respective heights to the length of the edge of their square base. The system of rectangular Prisms may contain many series according to the particular prisms which vary from each other in the relative dimensions of their planes. The individuals of the system belonging to right rhombic

Prism will form a great number of series of particular rhombic prisms, varying from each other in their relative heights, and in the angle at which the lateral planes incline to each other. Those of the system of crystallization belonging to the Rhomboid will comprehend a great number of series, according as the Rhomboids differ in the angles at which their planes incline, respectively, to each other, &c.

§. 57. Methods for ascertaining the Angles of Crystals.

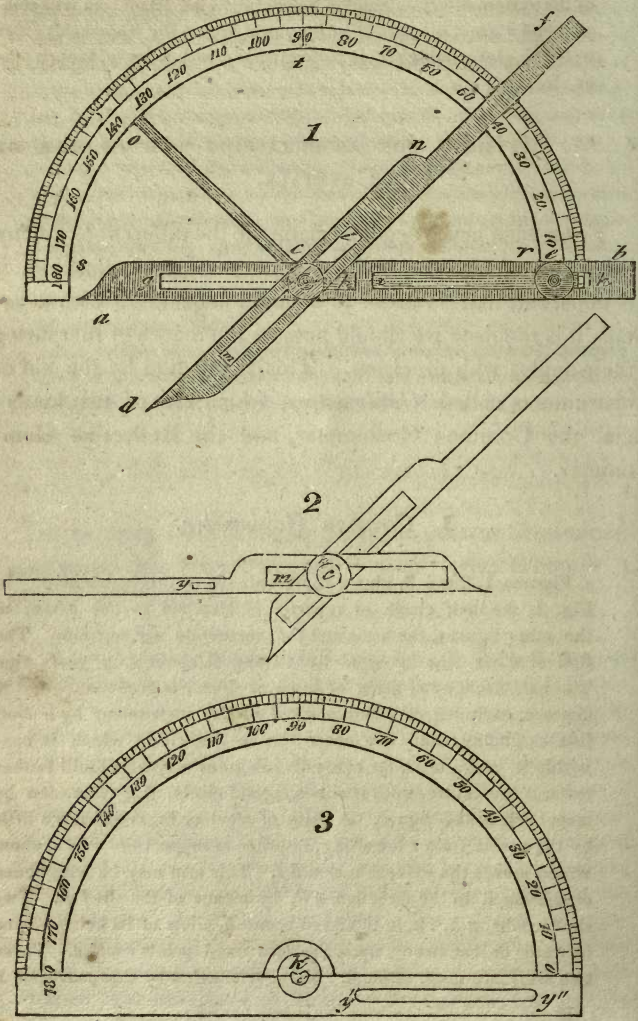
From what has preceded relating to the differences among the forms of crystals, and the systems of crystallization, it is apparent, that in order to become acquainted with crystals, it is requisite we should possess the means of measuring their angles with precision. This is effected by the aid of instruments called *Goniometers*, which are of two kinds: viz. the Common Goniometer, and the Reflective Goniometer.

1. *Common Goniometer.*

Figures 1, 2 and 3, give a representation of this instrument. In Fig. 1, the half circle or reporter is attached to the arms; in the other figures, the arms and the semicircle are separate. The first of these was invented by Carangeol about fifty years ago. The half circle *s t r*, made of brass or silver, is graduated into 180 degrees, each degree being marked on the instrument by a short line extending from the outer rim to the circle which is next within it, and a mark for every five degrees extending still farther towards the centre, until it cuts a second circle, as may be seen by inspection of the figure. A plate of steel or brass extends a little by the centre from *r* towards *s*, in order to support the axis *c*, about which moves the moveable arm *d f*. This arm may be lengthened or shortened in the direction *c d*, by means of the slit *l m*. Two similar slits, *g h*, *i k*, in the fixed arm *a b*, allow of its being moved forwards or backwards upon the two fixed points *c* and *e*. These two arms are made of steel. It is obvious that by this provision, it

is in our power to apply a greater or less length of the arms to the planes whose incidence is to be measured, according as those faces

Fig. 134.



are large or small. In either case, the number of degrees, or the value of the angle, is indicated at the border *f n* of the moveable arm, which coincides with a line coming directly from the centre of the circle. It is necessary that the arms be applied to the planes whose inclination is required, perpendicularly to the edge at which they meet. But it frequently happens that the crystal we are wishing to measure is engaged along with other crystals in its gangue, so that the extremity *s* of the semicircle prevents the application of the arms to its planes: in order to remedy this obstacle the semicircle is cut into two parts at *t*, and reunited by a hinge. In this way we are able, when it is necessary, to turn the part *s t*, back upon the other, which we restore again to its original place, when we have adjusted the arms to the planes under examination, in order to read off the degrees of the measured angle.

Figures 2 and 3 represent the common goniometer, which consists of two parts; the steel arms Fig. 2, constituting one part and the semicircle Fig. 3, the other. When we have adjusted the arms to the angle to be measured, they are transferred to the semicircle in order to read off the degrees. But it is obvious that in using this variety of the goniometer, it is indispensable, in adjusting the arms to the semicircle, that we place the centre of them upon the centre of the semicircle, and one arm upon its diameter. This is effected with ease by the following construction of the instrument. The pin which connects the arms at *k* is allowed to project a little upon one side, and a hole is made in the cross piece Fig. 3 at *k*, exactly large enough to receive it; besides, there is a little projection upon the cross piece at *y*, against which the lower edge of that arm may repose, which requires to be exactly upon the diameter of the circle, when the angles are read off. The method of using it is, after having applied the edges of the arms to the planes of any crystal, to tighten them by means of a little screw at *k*, and transfer them to the cross piece of the semicircle, allowing the projection to drop into the hole *k*, and one of the arms to rest with its under edge upon *y*; the other arm will then indicate upon the reporter, the number of degrees which the measured angle contains. This construction of the common goniometer will be found more convenient in its application than that first described, and on the whole, less liable to inaccuracies in consequence of the greater steadiness of the semicircle, and of the greater exactness with which the arms may be fitted to crystals.

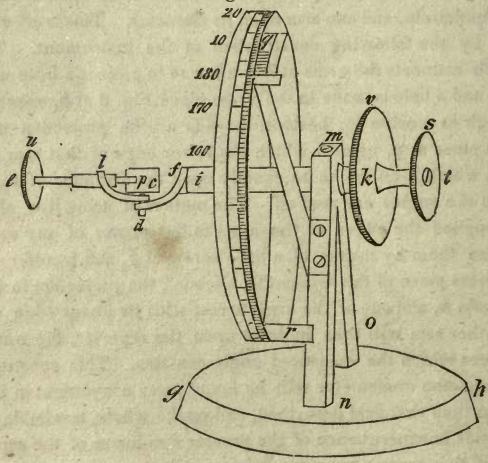
In making use of the common goniometer, great care should be exercised in selecting crystals with smooth and plane faces; and when

the arms are applied to a crystal, they should be previously brought sufficiently near together to form a more acute angle than that about to be measured. The arms being then gently pressed upon the crystal, they will gradually separate until they come to fit the planes so exactly, that when held between the eye and the window, no light can be perceived to flow between them. When the crystals are well adapted to these measurements, and in the hands of a person familiar with the operation, results may be obtained from any number of successive trials, whose greatest difference will not be above a quarter of a degree.

On the whole, the common goniometer, may be said to supply us only with approximations to the real value of the angles of crystals, in consequence of the frequent irregularities upon their planes, or the minuteness of their planes, as well as the difficulty of applying the arms in a direction perpendicular to the intersection of the planes to be measured. Still, it is an instrument indispensable to the Mineralogist; and is in general every way adequate, in point of the accuracy of its results, to be employed in the determination of minerals.

2. *Reflective Goniometer.*

Fig. 135.



This instrument, which is of invaluable utility to the Mineralogist, was an invention of the late Dr. Wollaston. It is represented in Fig. 135. It consists of an entire circle, divided into degrees

upon its edge, and disposed vertically upon a moveable, horizontal axis *ik*, which is supported by the braces *mn* and *mo*, inserted into the circular horizontal foot *gh*. This circle is furnished with a vernier *q*, which is attached to the support *mn*. The axle *ik* is hollow, and traversed by a second one *tf:* both may be revolved upon themselves by means of the circular wheels *v* and *s*, with this difference, that the lesser wheel turns only the interior axis, the outer one, together with the circle, remaining stationary; whereas, the larger wheel turns all at once, the exterior axle, the circle which is adapted to it, and the interior axis.

The interior axis is prolonged from *f*, at first by a semi-circular projection, consisting of two pieces and joined together by a rivet at *d*, so as to allow of motion in the portion *ld*. Its extremity *l* is pierced and traversed by a round stem *ep*, capable of being moved up and down, and at the same time of being turned circularly by the little wheel *u*. The extremity *p* is slit so as to receive a small copper plate *c*.

The instrument is used as follows. It is first placed on a small pyramidal stand, and the stand on a steady table. The stand should be of such a height above the table as to permit the experimenter to sit with both elbows upon the table, while his eye shall not be elevated above the axis *ik*. The stand should be firmly attached to the table, and the goniometer to the stand. The table is now placed before a common flat window, at the distance of from six to twelve feet, in such a manner, that the vertical wheel or circle shall be as nearly as possible perpendicular to it. A black line is drawn on the wainscot, between the window and the floor, perfectly parallel with the horizontal bars of the window. The crystal to be measured is attached, by means of a piece of wax, to the plate *c*, or (dispensing with the use of the plate *c*) to a piece of wax half an inch long, extending horizontally in the direction of the axis *ik*. In attaching the crystal, we endeavor to adjust it, so that the edge formed by the meeting of the two planes whose inclination is sought, shall coincide with an imaginary line passing through the axis *ik*. It is impossible to effect this simply by inspection: the following steps are therefore taken to ensure the accuracy of this adjustment. One of the planes forming the angle sought is brought uppermost, and so as to be as nearly parallel to the table as possible, when the eye is placed so near that the lower lid nearly touches it: in this situation the crystal is not seen, but we observe distinctly the images of objects reflected from the plane under the eye, and by giving a slight motion

to the lesser wheel, if necessary, we obtain reflections of some of the horizontal bars of the window. One of these, which is capable of being recognized, is selected to be employed in the experiment, and brought down by the turning of the axle so as to coincide with the black line upon the wainscot, as seen directly with the eye. It is seldom or never the case that the crystal, as first adjusted, affords this coincidence, the line visible in the face of the crystal almost always forming an angle more or less acute with the line on the wainscot seen directly. In order to effect this coincidence, we communicate to the crystal a variety of slight movements, by means of the hinge at *d*, or of the little wheel *e;* by one or both of these motions the adjustment is brought about. This being done, the axis is turned and the same arrangement effected with regard to the other plane. Sometimes it happens, that in adjusting the second plane we disturb the first: a little attention will, however, enable us to fix them both in the requisite position. Both reflections being precisely arranged with regard to the black line, it is next requisite to observe that the line at 180 upon the circle forms a line with that at 0 upon the vernier, at the same time that the reflection of the window bar is seen along the black line. Now we have only to turn the exterior axis until the image of the bar reflected from the second plane is in like manner observed to coincide with the same line below. In this state of the instrument, the vernier at *c* will indicate the degrees and minutes at which the two planes incline to each other. Suppose the angle to be 105° 5′. In this case, we shall find 105 upon the circle, as the nearest number which touches the 0 on the vernier; still the line belonging to 105 upon the rim of the circle has perceptibly passed that corresponding to 0 on the vernier. In order to ascertain the precise measure of this distance in minutes, we notice which line on the vernier cuts, or forms but one line with another line on the principal circle. In the present case, it will be the line marked 5 on the vernier.

The method above described cannot, however, be followed to the best advantage by persons who are short sighted. Glasses cannot be used in these experiments, and the sight of such persons will not in general, allow of their observing the black line with sufficient distinctness without them. By the following arrangement, however, near sighted persons may use the reflective goniometer with the utmost accuracy. Let a cyphering slate be set up on edge by means of two cross pieces of wood, so that it shall stand perpendicularly and steadily upon the table between the goniometer and

the window, with its upper edge nearly on a level with the axis of the instrument. Let a horizontal line be drawn with a knife across the slate near its upper edge and parallel (as in the case of the black line on the wainscot,) with the bars of the window. Now let the slate be fixed exactly at such a distance from the observer, when his eye is at *c*, that he can most distinctly perceive the horizontal mark upon the slate. Here let it be made stationary upon the table. In this situation, the horizontal mark on the slate is to be substituted for the black mark first described. But instead of the reflection of a window bar, if the table should be situated near the window, it will be better to substitute a piece of wood of half the diameter of a window bar, placing it across half way between, and parallel with, two contiguous bars, since a window bar will give at this distance an image whose diameter is greater than is requisite, and thus diminish the accuracy of the coincidence we obtain with the line upon the slate.

The instrument whose use has just been described has a remarkable advantage over the common goniometer not only in the accuracy of its results, which in perfect crystals may be said to give the value of angles within a minute of a degree, but in its application to crystals of the smallest dimensions; it being estimated that it will give the inclination of planes whose area is less than $\frac{1}{100000}$ of an inch. Indeed, the smaller the crystal is, in general, the more eligible it becomes for the measurement of its angles by this goniometer, since in such crystals, inaccuracies are less liable to occur from the curvature of the crystalline faces, than in those which are of larger dimensions.

Notwithstanding the superiority of the reflective over the common, goniometer in most cases, both instruments are indispensable in the cabinet of every Mineralogist. Occasionally, crystals are too large or are deficient in polish, for the use of the reflective goniometer, in which case, the common one must be resorted to. The common goniometer has an advantage over the reflective one in being a pocket instrument, as well as in the facility of its application where the crystals are of a suitable size: the reflective goniometer, however, must be employed on all occasions when the crystals will allow of it, where the object is to describe accurately a new form of crystal, or to establish the system of crystallization belonging to a species not yet generally known.

§. 58. Structure.

The internal structure of crystals depends upon the connexion existing among their particles. It may be observed by mechanically overcoming this connexion.

In effecting this separation, smooth and polished surfaces are often produced in certain directions, and when a smooth surface is thus produced in any direction, others may also be effected in the same direction. Two or more of these being developed in a crystal, give origin to plates or laminæ, from whence the expression, *foliated* structure or *laminated* structure, which has been applied to such crystals.* In other directions, the application of force only produces uneven faces, between any two of which thus produced, no parallelism exists.

The production of even and polished surfaces, in causing the separation of the particles of crystals, is denominated their *cleavage;* of uneven and irregular surfaces, their *fracture.* The fracture of crystals will be treated of hereafter.

It is sometimes difficult to ascertain the cleavage of crystals, and very often equally so, to discover their fracture. The particles of Galena and Calcareous spar, separate so readily in the direction of their cleavages, that it is almost impossible to effect a separation in any other direction. On the contrary, others, as Quartz and Tourmaline, separate in other directions with greater facility than in those of their cleavage, so that it becomes difficult to observe even the traces of its existence.

§. 59. Cleavage.

A crystal is said to be cleavable, or to admit of cleavage, if, by the application of mechanical force, it splits into parallel layers.

---

* Lapidaries have long been acquainted with this property in many of the gems, especially in the Diamond, which possesses a laminated structure in four directions; a peculiarity of considerable importance in the cutting of this gem, since by means of it, flaws, and badly colored portions, are easily got rid of, without the trouble of being ground down, as in other gems.

Crystals of certain species cleave with the greatest facility, as those of Carbonate of Lime, Fluor, and Galena, which require merely a slight shock from a hammer to cause their separation into fragments with even and parallel faces; while those of other species, as Arragonite and Apatite, require the aid of a knife or chisel, and a delicate mallet, in order to arrive at the same result. It is frequently necessary to learn beforehand the direction of the cleavage, which may be done by holding the crystal in a strong light, the reflection of which renders the natural joints at once visible.

A little practice is required in order to cleave minerals with neatness. Crystals of Fluor, Calcareous Spar, Blende, and Sulphate of Strontian, may be recommended to the student as good examples for his early exercise.

§. 60. Cleavage Planes.

The faces which result from cleaving a crystal may be termed its cleavage planes.

Cleavage planes differ with respect to the lustre they exhibit. Those which are parallel, in the same crystal however, are always similar in this respect, while those which are not parallel often present considerable diversity. That it is perfectly easy from these differences to ascertain the similarity or dissimilarity of cleavage planes in a crystal.

§. 61. Direction of Cleavage constant.

The direction in which the crystals of a species allow themselves to be cleaved is constant.

If two directions of cleavage exist at the same time, as in the crystals of Sulphate of Strontian, wherever the faces corresponding to them are obtained, they always intersect each other at the same constant angles. This follows from the parallelism of all those faces of cleavage which lie in one and the same direction.

§. 62. Form of Cleavage.

A regular solid contained under cleavage planes is called a form of cleavage, or a cleavage crystal.

The directions of cleavage are somewhat various in crystals belonging to different species. In some crystals, but one is visible, several possess two, Galena and Calcareous spar, have three, Fluor four, and Blende six, while others still, possess cleavages in more directions than six.

As the planes produced by cleavage are parallel, a form of cleavage cannot result from less than three sets of cleavages. Nevertheless, if cleavage takes place in but two directions, provided these lead to the formation of a quadrangular prism, it may be said to produce a form of cleavage; since, if we arrive at a knowledge of the lateral faces of a prism, we possess independently of the cleavage, means for determining the base, whether it be horizontal or oblique.

It has been remarked, (§ 60,) that there exist differences among the cleavage planes of a crystal, by which one cleavage or one set of cleavages, are capable of being distinguished from others. The importance of this fact is very great. If we attempted to consider the forms of cleavage, or cleavage crystals, as they are formed from the whole of their cleavages, we should sometimes have forms too complicated to be understood. We therefore describe separately the solids resulting from the meeting of cleavage planes of the same kind, which will lead us to point out in a few instances, more than one form of cleavage as belonging to the same crystal.

The following are the different forms of cleavage which have hitherto been observed.

1. The *Cube*, (Fig. 33.) Three cleavages, with equally brilliant and even planes, perpendicular to one another. Examples—Galena, Grey Cobalt and Leucite. This last mineral presents, in addition to the foregoing, six other cleavages, which afford planes parallel to the sides of a regular rhombic Dodecahedron.

2. The *right square Prism*, (Fig. 40.) Three cleavages, two producing similar planes, and all perpendicular to each other. Examples—Idocrase and Scapolite.

3. The *right rectangular Prism*, (Fig. 41.) Three cleavages. perpendicular to one another; but no two of which are similar, Examples—Olivine and Wolfram.

4. The *right rhombic Prism*, (Fig. 42.) Two cleavages of equal degrees of distinctness, not perpendicular to one another; and a third, perpendicular or at right angles to the first. Examples—Sulphate of Barytes and Staurotide.

5. The *right oblique angled Prism*, (Fig. 43.) Two cleavages, not at right angles to each other, unequally distinct; and a third, perpendicular to the first. Examples—Epidote and Sulphate of Lime.

6. The *oblique rhombic Prism*, (Fig. 44.) Two cleavages, equally distinct, not perpendicular to one another; and a third, forming an equal oblique angle with each of the first. Examples—Hornblende and Pyroxene.

7. The *doubly oblique Prism*, (Fig. 45.) Two cleavages, unequally distinct, not perpendicular to one another, and a third, inclining differently to each of the first. Examples—Feldspar and Sulphate of Copper.

8. The *regular Octahedron*, (Fig. 35.) Four cleavages, equally distinct, and equally inclined to an axis, (under the angle of 35° 15′ 51″,) so that any two of their opposite intersections are perpendicular to each other, or so that the three sections through the edges are squares, and that the faces are equilateral triangles. Examples—Fluor and Diamond.

9. The *Octahedron with a square base*, (Fig. 37.) Four cleavages, equally distinct, and equally inclined to an axis, so as to form equal isosceles triangles, and so that the three sections through the edges are in one instance a square, and in the others, rhombs. Examples—Zircon and Tungsten.

10. The *Octahedron with a rectangular base*, (Fig. 38.) Four cleavages, disposed about an axis under two different inclinations,—the two on opposite sides being equally inclined and equally distinct; from whence it follows, that the triangles are all isosceles, but of two different kinds. Example—Arseniate of Copper.

11. The *Octahedron with a rhombic base*, (Fig. 39.) Four cleavages, equally distinct, equally inclined to an axis, but so as to form scalene triangles, and that the sections through the edges are rhombs. Example—Sulphur.

12. The *Rhomboid*, (Fig. 46.) Three cleavages, equally distinct, and equally inclined among one another. Examples—Carbonate of Lime and Corundum.

13. The *regular Dodecahedron*, (Fig. 36.) Six cleavages, equally distinct, and uniting two and two upon an edge, under an angle of 120°. Example—Blende.

14. The *regular six sided Prism*, (Fig 47.) Three cleavages, equally distinct, parallel to the axis of the crystals, intersecting each other, under angles of 120°; and a fourth, perpendicular to the first. Examples—Emerald and Phosphate of Lead.

The last substance has cleavages also, equally distinct in six directions; viz. parallel to the terminal edges of the prism, which result in a Dodecahedron with equal isosceles triangles.

§. 63. But one Form of Cleavage (generally) in the members of a species.

The various crystalline forms belonging to any one species afford in general, the same form of cleavage.

By this we are not to understand, that but one solid in the majority of cases is actually obtainable by cleavage in whatever way it may be performed; the proposition is only true, when a simultaneous cleavage is effected in every direction, in a crystal that affords similar cleavage planes. For it is obvious, that if in the case of Fluor, whose cleavage solid is a regular Octahedron, we omit to cleave parallel with certain of its planes, and cleave only parallel with the others, we may obtain a Tetrahedron or an acute Rhomboid. Likewise in Blende, where the cleavage form (obtained by all the similar cleavages) is a regular Dodecahedron, we may obtain by partial cleavages an obtuse Rhomboid, an Octahedron, an acute Rhomboid, and an irregular Tetrahedron.*

It has been said, however, that the crystals of some minerals possess many cleavages, and in some instances two sets of cleavages, may each result in forms of cleavage, which will disagree, as in the case of Phosphate of Lead, whose crystals besides cleaving parallel to the sides of a regular six sided Prism, also afford a Dodecahedron with isosceles triangular faces. These instances are however, very rare. In general, the additional cleavages (which rarely take place in more than one direction) are of such a nature as to lead to no regular solid, and are therefore denominated *supernumerary cleavages*.

§. 64. Relation between forms of Cleavage and Crystals.

Forms of cleavage, either represent members of the series of crystallization of those species from the individuals of which they have been extracted, or those individuals

---

* See Brooke's Crystallography, p. 40, et seq. where these results are illustrated by diagrams.

may be conceived to be derived from their cleavage solids, agreeably to the symmetrical transitions explained in §. 50.

1. Thus the form of cleavage in Galena is a Cube, which corresponds with the most common form of crystal belonging to this mineral: that in Idocrase a right square Prism, and that in Muriacite a right rectangular Prism; in both of which cases, there exists the same correspondence as in the first.* Additional instances among

---

* It may appear to the student, who has made trial of cleaving crystals, somewhat arbitrary to distinguish the three kinds of quadrangular prism referred to above, in all of which the angles are 90°; since it is obvious from the nature of cleavages that any crystal capable of affording one, may also give rise to the other two; from which it would naturally seem, that these three forms of cleavage should rather be treated of as one. But if we pay attention to the nature of the cleavages in the three cases, we shall perceive there is good cause for the distinction introduced.

For example, if (as is the case) in a crystal of Galena, a parallelopiped with square faces, the three cleavages are equally distinct, it is evident that any one of the three faces of the prism (with its opposite) sustains the same relation to the others, as the cleavage which corresponds to it, does to the other cleavages, that is, they are all similar, and may be regarded as being situated at an equal distance from a central point, as is the fact with the faces of the Cube. This solid is therefore, very properly denominated a *Cube*.

If two kinds of cleavage are equally distinct; and the third more or less so than the first, or scarcely perceptible at all, as is the fact in the crystals of Idocrase, the four faces which result from the similar cleavages are similar, and similarly situated as respects an imaginary line joining the centres of the two other faces; this line must therefore be considered as the prismatic axis, and then, in order to represent the similarity of position among the lateral faces to this axis, we must consider the bases (i. e. the other faces) as square; which makes the solid in question, the *right square Prism*.

If the three cleavages, parallel to the faces of the right quadrangular prism, are unequal as respects their distinctness, as in Muriacite, then each of the three sets of faces of the prism considered along with the corresponding cleavages, may be regarded as distinct from one another,—a

the forms of cleavage crystals are, the octahedral form of cleavage in Fluor and the Diamond, the dodecahedral in Blende, the rhomboidal in Carbonate of Lime, and Bitter Spar, and the hexagonal in Apatite; in each of which species, the same forms occur among their natural crystals. In these cases, and others which are similar, it is to be understood that the faces under which the form of cleavage is contained, are parallel to the faces of the crystalline form, and therefore the solids are perfectly similar in the relations of edges and angles.

In the correspondence above referred to, abstraction is made of those slight alterations which crystals suffer in consequence of the replacement of their edges and angles.

2. But there are a few instances where the solid yielded by cleavage, does not resemble the crystal from which it is obtained, or any others of the same species. Of this, the form of cleavage in Corundum which is a Rhomboid, is an example. The form possessed by the crystals of this substance, is either that of an hexagonal Prism, or of an hexagonal Prism surmounted by a six sided pyramid. A second example of this disagreement occurs in the cleavage forms of the Leucite, which (as has before been noticed) are, a Cube, and a rhombic Dodecahedron, while its only crystalline form is that of the trapezohedron.

According to the present proposition, the hexagonal Prism is derivable from the Rhomboid, and the trapezohedron from the rhombic Dodecahedron, agreeably to those transitions of one form into another from symmetrical replacements upon their edges or angles, or both. That this is the case, may be perceived by referring to §. 50. If the hexagonal Prism be shown to sustain this relation, it

---

peculiarity, in the right quadrangular prism, particularly denoted by the right rectangular Prism.

Where the form of cleavage presents solids, contained under dissimilar faces, as the right rectangular Prism, it is natural to infer that those cleavages which are parallel to the larger faces, will take place with greater difficulty than those parallel to the smaller faces, since the resistance produced by a large surface must necessarily be greater than that by a small; accordingly, those faces which correspond to cleavages, effected with the greatest facility, and which of course present the most distinct planes, are regarded as the lesser, and those on the other hand which are effected with more difficultly, are conceived to belong to the larger faces.

is plain, that the hexagonal Prism terminated at both extremities, with six sided pyramids, (whose faces correspond to those of the prism) or even the Dodecahedron with isosceles faces may be said to come into the same connection; since both these forms flow from the hexagonal Prism, simply through the truncation of its terminal edges.

§. 65. Relation between Forms of Cleavage and Primary Forms.

The forms of cleavage and primary forms, (in those systems of crystallization where the former are observable,) are identical.

Those forms which are obtainable by cleavage, or which may be inferred to exist from certain appearances, are similar to the solids which are considered as the primary forms; and among the crystals of the different species, the one may be substituted for the other.

But it will no doubt be recollected, that in two or three instances, the crystals of the same mineral yield two different cleavage forms. In these cases, we have two primary forms, either of which may be selected,—the choice being regulated only by a single circumstance; viz. the predominance of one of the forms among the secondary crystals of the mineral. Thus, in Phosphate of Lead, the cleavages are parallel to the sides of an hexagonal Prism, and of a dodecahedron with isosceles faces; but as the crystals are decidedly prismatic in their shape, the former is regarded as the primary form.

§. 66. Primary Form, in the Absence of Cleavage, how established.

When no cleavages are observable among the crystals of a mineral, the primary form is chosen from analogy.

Thus, the crystals of Native Gold, (which are Octahedrons unmodified, and Octahedrons with their edges and angles truncated; Cubes and Dodecahedrons,) possess no indications of cleavage; but as they assume those forms which other minerals affect whose cleavage forms are Octahedrons, the Octahedron is presumed to be the primary form in this instance.

The primary form which is selected, must always allow of the derivation of all the forms belonging to the series of crystallization, agreeably to the rules of derivation explained in §. 51.

§. 67. Directions for Ascertaining the Primary Forms of Crystals.

The rules for discovering the primary forms of crystals, depend upon the indications of cleavage, where it is observable, and upon analogy, where it is not.

1. *Crystals possessed of Cleavage.*

(*a.*) If a crystal has the form of one of the primary solids, either entire or altered by modifications, that form is its appropriate primary, unless the cleavages it possesses are incompatible with such a form; in which case, the particular solid developed by mechanical means, is the true primary. For example, if the crystal be a Cube of Galena, on making a trial to learn its cleavages, we perceive they are three in number, and that they take place parallel to the faces of the crystal with the same facility in each direction; the Cube is therefore inferred to be the primary form of the crystals of Galena. Again, if we seek for the cleavages in a cubic crystal of Fluor, we do not find them, as in the former example, parallel to the faces of the crystal, but in an oblique direction, to the number of four, and leading to a solid having the form of a regular Octahedron, which is the primary form of the species. In the hexagonal prism of Corundum also, we find no cleavages coinciding with the faces of this form, but three which tend to the developement of a Rhomboid, the primary form in this instance, &c.*

---

* In consequence of the irregularity of crystals, (§. 53,) considerable embarrassment will occasionally be experienced in recognising the planes of a primary solid, in a crystal where they exist. The secondary planes, although symmetrically disposed, are nevertheless very often disproportionably extended, so as greatly to disguise the true character of the crystal. A little experience in reading crystals, aided by a few general rules, will soon overcome the difficulty.

Several of the forms are not liable to give rise to perplexity, in their determination. Such are the Tetrahedron and the rhombic Dodecahe-

(*b*.) If the crystal does not occur under one of the primary forms, but under one of those new figures which we have seen, in §. 51, are capable of being derived from the primary forms by symmetrical modifications, in these cases, (from our knowledge of the relations of the various new figures, as they have been called, to the primary solids,) we shall be able, in general, to say,—that a crystal of this sort belongs to some one of two or three of the primary forms, and in a few cases we are sure of the identical form from which it comes. Thus, if the crystal is a trapezohedron, we know it can come only from the Cube, the regular Octahedron, or the rhombic Dodecahedron. If a pentagonal dodecahedron, it must have for its

---

dron. The different varieties of octahedron are also distinguishable from each other, by the angles at which their several planes respectively meet, as well as by the symmetry of their modifications. (§. 50.)

The different species of parallelopipeds, are the most difficult forms among crystals to be identified. With regard to a crystal of this denomination, we should first observe whether it possesses a series of planes whose edges are parallel to each other. If we observe such a series, we should then hold the crystal so as to bring the parallel edges into a vertical direction. When thus situated, we should observe whether there be any plane at right angles to the vertical planes.

It sometimes happens that agreeably to the foregoing directions, the crystal will possess two sets of vertical planes, according as one or the other of two sets of parallel edges are placed upright. In such a case, we should endeavor to ascertain whether the planes belonging to one set are not so symmetrically arranged with respect to those of the other as to possess the character of modifications of the terminal edges of the predominant form; if this should be the case, we should not make them the vertical planes.

If there be a series of vertical planes, and a horizontal plane, we should observe whether any of the vertical planes are at right angles to each other, and whether there be any oblique planes lying between some of the vertical planes and the horizontal plane. We should remark the equality or inequality of the angle at which any of the vertical or oblique planes incline on the several adjacent planes.

We will suppose a parallelopiped with oblique planes, situated between the vertical and horizontal planes: if the inclination of the former planes is uniform to the adjacent vertical and horizontal ones, it belongs to the right square Prism, provided the vertical planes are perpendicular

primary form a Cube; if a dodecahedron with scalene triangular faces, it can come only from the Rhomboid.

Where one of these new forms is capable of being derived from several primary forms, the student should seek directly for the cleavages, which will at once settle the question.

2. *Crystals not possessed of Cleavage.*

Among crystals of this kind, which are not numerous, the student will be liable to experience occasional embarrassments. In general, he should endeavor to procure several forms of the same substance;

---

to each other; and to the right rhombic Prism, if these planes incline to each other alternately, at an acute and an obtuse angle. Again, we will suppose similar oblique planes to belong only to the opposite terminal edges, and the vertical planes to be at right angles to each other; the primary form, in this case, is a right rectangular Prism.

Let us suppose a crystal to be contained within any series of vertical planes, and to be terminated, not by a horizontal plane, but by a single oblique plane; it will belong to the oblique rhombic Prism, the doubly oblique Prism, or the Rhomboid.

If, instead of one oblique plane, there be four, inclining to each other at equal angles, the crystal may belong to the right square Prism, or to the Octahedron with a square base. If there be four oblique planes, each of which inclines on two adjacent planes, at unequal angles, the crystal will belong either to the right rectangular Prism or right rhombic Prism, or to the Octahedron with rectangular or rhombic bases.

If the series of vertical planes consist of twelve, eighteen or twenty four, and if there be a single horizontal plane, the crystal will probably belong to the hexagonal Prism. If there should be six, nine, twelve, or some other multiple of three, and three oblique planes, the primary form is the Rhomboid.

It is by thus noticing the symmetrical arrangement of the vertical planes, or of the oblique planes, if there be any, that we are able to refer a complicated crystal to one of the primary solids.

Crystals belonging to the doubly oblique Prism are among the most difficult to be understood; and the student, in examining them, as well as very irregular crystals of other forms, will generally apply directly to the cleavage, the knowledge of which, though it be but in one direction, will often be sufficient to enable him to distinguish the primary planes.

this will enable him to fix upon the primary form, agreeably to the rule by which that form has been selected, (§. 66.) If, however, all the crystals within his reach have the same form, a knowledge of the relations of primary and secondary forms, and their transitions into one another and into new forms, will enable him to decide within one or two of the solid in question, which will often be sufficient for his purpose. Thus, if the crystal is a Cube, the primary form must either be identical with that of the crystal, or it must be a regular Tetrahedron, a regular Octahedron or a rhombic Dodecahedron, the only solids with which it comes into connexion. Is it an Octahedron with a square base? this form must be its primary, or the right square Prism, &c.

§. 68. Fracture.

A mineral when broken in a direction so as to make its irregular structure appear, or contrary to its cleavage, exhibits its fracture.

Cleavage relates to the smooth and even surfaces produced by breaking a mineral: *fracture* to those which are uneven. The latter property, though in general more easily observed in a mineral than the former, is nevertheless of considerably inferior consequence on account of its want of constancy.

Fracture is considered here as a property of individuals, or of simple minerals in general; accordingly, several varieties of fracture frequently alluded to in works on mineralogy, will be treated of under compound minerals, to which they relate.

§. 69. Kinds of Fracture.

The kinds of fracture are determined according to the quality of the faces produced: this may be said to be of four sorts; viz. 1. conchoidal, 2. even, 3. uneven, 4. hackly.

1. The *Conchoidal* represents that kind of irregular structure where the faces resemble the inside or the outside of a common bivalve shell, as a clam; and the terms perfectly, imperfectly, large, small, and flat, are sometimes appended to point out more minutely the size and concavity of the surface, though in general they are of but little importance.

2. *Even* is applied to such faces as are nearly flat. It is doubtful, however, whether this fracture can be said to occur except among compound minerals.

3. *Uneven*, when the surface is irregular, without presenting any shell-like concavities or elevations.

4. *Hackly*, which results rather from the tearing than from the breaking of a mineral, is applied to surfaces covered with little hook shaped filaments, very perceptible to the touch.

§. 70. Surface.

The kinds of surface presented by minerals may be considered under four heads; viz. 1. faces of crystallization, 2. faces of cleavage, 3. faces of fracture, 4. faces of composition.

Of all these kinds of faces, the most important are those which are even, since, in the mineral kingdom, the uneven faces are not subject to any constant law. The even faces are confined to the faces of crystallization and the faces of cleavage.

1. *Faces of crystallization.* The different qualities of the faces of crystallization depend upon their being *smooth*, without any regular elevations or depressions; upon their being *striated, rough*, or *drusy*.

Smooth faces may be said to be the most abundant among crystals. We include, however, under this term such as sometimes have slight elevations and depressions, provided they are so faint that the general appearance of eveness and continuity of the faces is not effected by their occurrence.

Striated faces are those upon which we observe parallel grooves or striæ. These are frequent among minerals; and their observation is of great importance, since they are confined to particular planes and assume a constant direction. For example, in Quartz, the alternate lateral faces are striated horizontally; in cubic crystals of Iron Pyrites, all the faces are striated with this remarkable peculiarity, that the striæ are parallel to each other upon parallel faces, and perpendicular to each other upon such faces as are not parallel; in Titanite and Beryl, the prismatic faces are striated longitudinally, &c.

Rough or *Drusy*. This property of the surface of crystalline forms arises from elevations projecting from the faces of the crystals: the only difference in the application of the terms arises out of the size of the elevated particles. Thus, among those octahedral crystals of Fluor which consist apparently of minute cubes, we have frequent instances of these varieties of faces. The faces of such octahedrons cannot be planes; but they consist of the faces of cubes, which are perpendicular upon each other, and so situated, that a plane passing through their solid angles would be parallel to the faces of the octahedron. The smaller these cubes are, the more the general faces of the Octahedron will assume the appearance of exact planes. They are said to be *drusy*, if the asperities upon the faces are still easily distinguishable; they are termed *rough*, if they are only perceived with difficulty, or if the existence of such asperities can merely be inferred from the want of lustre. Instances of drusy faces often occur in like manner among the crystals of Quartz. A great number of prismatic crystals appear as if grouped parallel to each other, or round a larger crystal of the same kind.

In the above instances those particles which project from the faces of the crystals must not be considered as single individuals; and crystals with drusy faces are therefore, not compound minerals. They indicate rather the gradual progress of the formation of crystals from the interruption in which they arise.

2. *Faces of cleavage*, present us with very little remarkable differences in their quality. Those which are smooth are frequently denominated *perfect*. Notice is sometimes taken of striated appearances, or parallel lines traversing cleavage faces, as in those of Feldspar, Corundum, &c. They are not attended, however, as is the case with striæ upon faces of crystallization, by elevations and depressions upon the faces, but originate in the flow of light, through natural joints of the crystals, in which this property is observable perpendicularly, or nearly so, to the planes in which it occurs. Its observation may occasionally be employed to advantage, in discovering the similar cleavages of a mineral.

3. *Faces of fracture*, differ in the greater or less smoothness of their inequalities, and according to this measure in particular, the different kinds of fracture are said to be more or less perfect.

4. *Faces of composition*, which are those in which several individuals touch one another, are sometimes even, yet this is not common, and when they are so, there is no danger of confounding them along with faces of cleavage; because those particles which are contained

between two faces of composition, can no more be cleaved in the same direction after their separation, unless they possess a cleavage of that kind, in which event, the quality of the two kinds of faces, would suffice for their distinction.

Faces of composition are rarely smooth; and if this happens, we find it only in single, and not in continuous parts of the faces. If they are streaked, the markings are irregular, and without any constant direction. Very often the faces of composition are rough, their lustre being of a low degree, or wholly wanting, which enables us to distinguish them readily from the faces of cleavage, where these two kinds happen to be parallel. They are sometimes uneven, or contain more or less considerable elevations and depressions. In such cases, we must avoid confounding them, with uneven faces of fracture, by comparing them with real faces of fracture in the same individual.*

SECTION II.

COMPOUND MINERALS.

§. 71. Regular and Irregular Composition.

The mode of composition in which individuals occur is said to be *regular*, if the form produced by their union is a regular one; if the contrary takes place, the composition is said to be irregular.

If two or more homogeneous individuals join in a compound form, regularly and symmetrically, the composition is as much determinable as the form of a single crystal. For we may indicate with the utmost precision, in which faces of the simple forms, or in which plane the individuals cohere, even though this plane should not be parallel to a face of any simple form of that species to which the individuals belong. A composition of this kind is said to be regular.

* The character by which the faces of composition essentially differ from those of crystallization and of cleavage, consists in the circumstance, that generally they preserve no determined direction, and do not produce any regular forms.

On the other hand the composition is irregular, if the forms are not connected in the manner above described; but rather in such a manner as not to give rise to any regular or symmetrical forms. Individuals joined in this way are said to be *aggregated.*

There are compound minerals, which affect regular external forms, although their composition is in fact irregular. The regularity of the form in such cases evidently does not follow from the composition, but it must originate from something which is foreign to the mineral. Compositions of this sort cannot be called regular in the sense of the word now explained.

§. 72. Regular Composition of two Individuals.

The regular composition of two homogeneous individuals, joined in one crystalline form, has been called a *Twin-crystal.*

The peculiar character of Twin crystals is, that the face of composition is in close and exact connexion, and that the plane in which they unite is either parallel to the face, or perpendicular to the edge of a form belonging to the series of crystallization of the species. The situation of the two individuals connected, is conceived of, if we suppose both to be in a parallel situation, and then one of them to be turned round a certain line under an angle of 180°, while the other remains unmoved. This line is termed the axis of Revolution, and it is possessed of a determined direction, being either perpendicular to the face of composition, or it coincides with this face, while it is parallel to one of the ordinary axes of the individual. The angle of 180° is the *angle of Revolution.* The resulting form is frequently called a hemitrope;—a term expressive of the idea of the demi-revolution which is supposed to have taken place.* The term *macle* was first applied to such forms by Romé

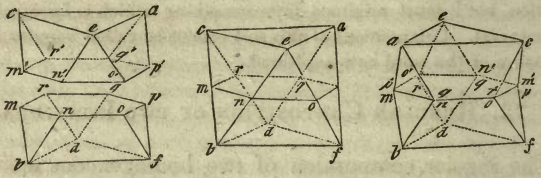
* It is scarcely necessary to say that it is not really believed that regular compound crystals were actually formed in this way; our only reason for making use of such language is the facility it affords in comprehending the structure of these crystals.

The term *hemitrope*, however, is rather confined in its application to twin crystals, including only such as are capable of being explained, by supposing a single crystal to be bisected in a determined direction, and one of the halves to be turned in the plane of bisection through 180°.

de Lisle, a name at present but little employed, in consequence of its more general application as the denomination of a species in mineralogy.

This kind of structure will become apparent from a careful attention to the following examples.

Fig. 136. Fig. 137. Fig. 138.



If, in Fig. 136, the halves of a regular Octahedron, (obtained by placing that solid upon one of its faces and dividing it, in this position, by a horizontal section, equidistant from the upper and lower parallel planes,) be applied to each other, parallel to the face of section *m n o p q r*, Fig. 137, and then made to revolve upon an axis perpendicular to the plane of junction through 60°, or one sixth of a circle, a twin crystal, Fig. 138, will be formed. Or we may suppose that the crystals instead of being thus bisected, and only the half of each made use of, were applied so as mutually to penetrate each other, and that the revolution, above described, took place in the compound crystal where the sectional planes *m n o p q r*, of the two crystals, coalesce. The compound crystal possesses angles not to be met with in either of the forms which are supposed to give rise to it; as may be seen in the meeting of the two planes, *c m' r'* and *f o p*, Fig. 138, which form what is called a *re-entering angle;* the angles also at which the two planes, *a c r' q'* and *b f o n* incline, are different from that at which any two faces meet in the regular Octahedron. This is called a *salient angle* in the present form. This variety of twin crystal, it will be observed from an inspection of Fig. 138, has three re-entering and three salient angles, which are all situated in an alternating order about the same horizontal plane *m n o p q r*.*

---

* Two individuals of the same form as that which gave rise to the twin crystal, just described, may penetrate each other in such a manner as to give rise to re-entering angles, as in Fig. 139. But here, the as-

Twin-crystals of this kind, are common among the forms of Octahedral Iron Ore and Spinelle.

2. Another kind of twin crystal occurs among the crystals of Hornblende, which may be conceived of in the following manner. If we suppose two crystals of the form of an oblique rhombic Prism, (Fig. 44,) whose lateral edges are replaced by the faces x, and whose terminal edges are truncated by the planes rr and $r'r''$, are made to penetrate each other, so that the vertical plane *abcd*, (which passes through the middle of the planes x, and which is a diagonal plane of the rhombic Prism,) in each, shall coincide, the result will of course be similar to Fig. 140. If now, the anterior portion, separated by the section *abcd*, undergoes a semi-revolution, or passes through the angle of revolution, upon an axis perpendicular to the sectional plane, the faces r' and r'' will come to the upper base, Fig. 141, with a small triangular portion of the lower base P, which will form a re-entering angle with the remaining portion of the upper base P. The re-

Fig. 140.

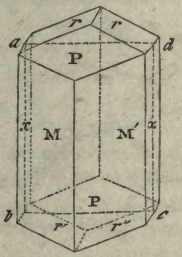
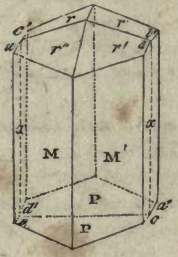
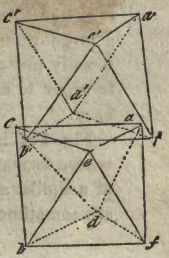


Fig. 141.



semblage of the two Octahedrons cannot be considered as a twin crystal, because the corresponding faces of the two forms, for example *a c e* and *a' c' e'*, are exactly parallel to each other. It will become obvious, on inspection, how different is the case with the faces of the twin crystal above described, in which it is seen that the respectively similar parts, in the composing crystals, have assumed that different, though fixed situation, with respect to each other, which is the peculiar character of the regular composition.

Fig. 139.



entering angle, in this twin crystal, is not always observable; sometimes it is effaced by the undue enlargement of the faces rr and $r'r''$, so that they join and form one termination, while the planes P P', whose faces correspond to the obtuse lateral edges, form the opposite termination.

3. Another twin crystal, common among the forms of Oxide of Tin, may be conceived of in the following manner. Supposing, as in the former instances the mutual penetration of two crystals, Fig. 142, is a composition of two right square Prisms, surmounted by four sided pyramids, whose prismatic axes coincide: the face of revolution $a\,h\,e\,y$, is situated parallel to the edge om of the pyramid. If the part situated above the plane $a\,h\,e\,y$ is made to undergo a semi-revolution, around an axis perpendicular to that plane, the twin crystal, represented by Fig. 143, is produced.

Fig. 142.

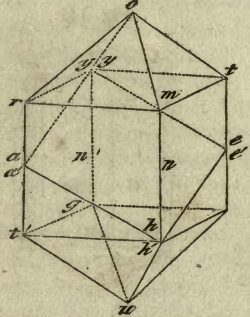
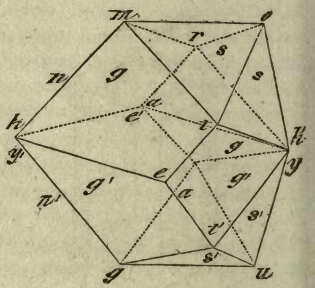


Fig. 143.



The regular composition just explained is never so simple as here represented: a large number of additional faces are usually present, which we have omitted, in order to render the explanation more easy.

Fig. 144.

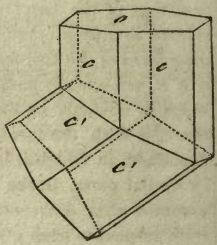


Fig. 144 is a twin crystal of Titanite, whose formation, it will be seen, admits of a similar explanation. These crystals are sometimes called *geniculated* forms.

4. Fig. 145 represents a crystal, in which the face of composition $a r^1 r^1 b$ is perpendicular to the axes of the aggregated crystals. By causing the part above the face of composition to revolve upon an axis perpendicular to that face, through 60°, the twin crystal, Fig 145, is generated. This form is met with among the crystals of Carbonate of Lime. Setting aside the new planes $t\,t$ and $t^1 t^1$ at the summits of this twin crystal, it may be seen, by consulting Fig. 131, how it differs from the crystals to whose composition it is due.

5. If we imagine two crystals of the form of a right rectangular Prism, terminated by four sided pyramids, to be placed with their broad lateral planes parallel, and made to penetrate each other, so that their axes shall coincide: and if one of the crystals, by revolving upon the common axis, through 90°, be conceived to emerge from its concealment in the other, it will originate the twin crystal, Fig. 146, which is a very frequent composition among the crystals of Harmotone.

Fig. 145.

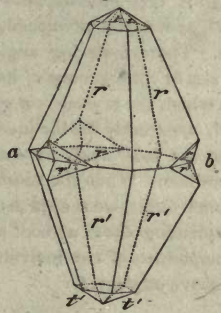
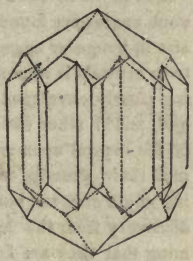


Fig. 146.



6. Let us imagine one of the irregular six sided prisms, Fig. 147, to consist of two similar individuals, whose axes (by the mutual penetration before described,) coalesce. Now if we suppose one of them to emerge, by revolving upon an axis perpendicular to the prismatic axis of the aggregated crystals, through 60°, we have the twin crystal there represented, which is a common form of Staurotide.

If the angle of revolution is 90°, we have a different twin crystal, as represented in Fig. 148, which is also a frequent composition among the crystals of Staurotide.*

Fig. 147.

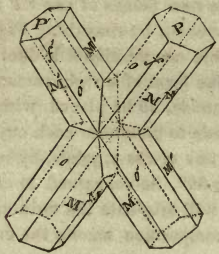
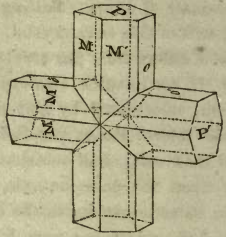


Fig. 148.



In detecting twin crystals, we are frequently assisted by the observation of the re-entering angles: though it very often happens that such angles are found in simple crystals, as was just mentioned, and also in irregular aggregates of crystals. The re-entering angle in twin crystals is sometimes not visible, also in consequence of its being closely enveloped in the gangue in which the crystals are engaged, and in other instances it is effaced, apparently by the increase of the crystal upon certain planes, after the individuals have assumed their situation as a regular composition. When the re-entering angle does not permit us to detect such forms, we are led to their discovery from the impossibility of explaining them without assuming that they are formed from the composition of two individuals, according to some one of the methods above explained.

---

* The two twin crystals just described, differ in other respects, than in the angle of revolution. In Fig. 148, it is perceived that the face M, of one crystal constantly corresponds to the face M, of the other crystal, the face *o*, to the face *o'*; and in Fig. 147, this correspondence does not occur: in the upper part, truly, the face *o*, corresponds to the face *o'*, and in the lower part, the face M, to the face M'; but, laterally, the face *o'* of one crystal, corresponds to the face M of the other, and the same of the rest.

§. 73. Regular Composition of more than Two Individuals.

The regular composition of three, four, five, or more individuals may be reduced to, and explained by, the regular composition of two individuals.

For example, Fig. 149 represents a regular composition of three individuals which occur in Chrysoberyl. The individual 1 forms with 2 a twin crystal, as in Fig. 147, and 2 may be conceived to form with 3 a second composition of the same kind.

Fig. 149.

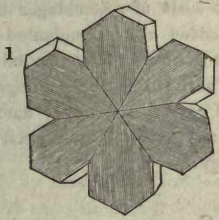


Fig. 150.

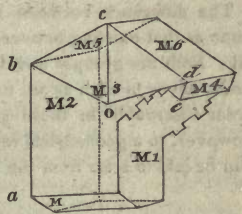


Fig. 150 is a regular composition of Titanite, consisting of a greater number of twin crystals; each of which is readily conceived of, by an attention to the faces of the crystal. The face upon which the crystal stands may be said to form with M one twin crystal; M with M^3, a second; M^2 with M^5, a third; M^5 with M^6, a fourth; M^6 with M^4, a fifth.

In the absence of re-entering angles, the striæ upon some of the planes of regularly aggregated crystals, are frequently of such a nature, as to enable us to understand their composition. Thus, the longitudinal markings upon the broad lateral planes of Fig. 149, render evident the different individuals entering into the form; and the lines which connect its re-entering angles, point out the faces of composition. In the crystal, whose composition is represented in Fig. 150, we observe on plane M^3 as well as its opposite, distinct lines, bisecting the angles *a b c*, *b c d*, and *c d e*, which meet near the centre of the face at *o*, and point out the faces of composition.

As respects the cleavage of compound crystals, the individual crystals possess the same cleavages as individuals not thus aggregated.

§. 74. Irregular Composition. Groupe and Geode of Crystals.

If several loose or imbedded crystals are merely aggregated, so that one becomes the support of the other, while there exists no general support, the assemblage is termed a *Groupe* of Crystals; if, however, several aggregated crystals are fixed to a common basis, so as to derive from it a general support, the assemblage is said to be a *Geode* of Crystals.

The difference between these two sorts of assemblages is the same as that existing between an imbedded and an implanted crystal. Both the groupes and the geodes refer only to compound minerals, never to such as are mixed. There is sometimes a degree of order observable in these groupes of crystals; it never amounts, however, to a geometrical regularity, and therefore, no regular form can be said to arise from the assemblage.

§. 75. Imitative Shapes.

The shape of a compound mineral is called an imitative or particular external shape, if it bears some resemblance to the shape of another natural or artificial body. Some of these forms are produced in a space not incumbered with matter, and depend upon the properties peculiar to the minerals themselves, without being influenced by any contiguous matter; others owe their shape to that extraneous or foreign matter with which they are surrounded. The latter of these have been called *extraneous imitative shapes*.

The groupes and geodes are the simplest modes in which the irregularly compound minerals appear in nature. If the individuals thus connected are diminished in size, and if their number at the same time increases, imitative forms are produced from the groupes

of crystals; which although they are founded in the nature of the individuals themselves, yet cannot be employed to any extent in the discrimination of minerals. The extraneous imitative forms do not depend upon the natural forms of the individuals, but merely upon the shape of the space previously existing, and are, therefore, entirely accidental.

§. 76. Imitative Shapes originating in the Groupes of Crystals.

The imitative shapes which originate from the groupes of crystals, are loose or imbedded, and more or less distinctly globular, or spheroidal masses.

If the individuals connected with each other become very minute, and at the same time unite with each other into a groupe of crystals, *globular* forms result, which are sometimes very perfect, at others very imperfect. Their surface is drusy, or covered with minute asperities, where it has not been disturbed in its formation, or by subsequent accidents. When broken open, the direction of the constituent individuals becomes apparent, and in most instances corresponds to the direction of the radii of a sphere, beginning in the centre and terminating at the surface. Imbedded globular shapes, like imbedded crystals, are complete on all sides, and leave an impression of their form in the mass from which they have been detached. Instances of imbedded globular shapes occur in Iron Pyrites, Chlorophæite, &c. When globular masses are attached to one another, they may produce *reniform* and *botryoidal* shapes, as in Malachite; but such instances are rare, and require to be distinguished from those described in (§. 77.)

The loose or imbedded globular shapes differ from grains and angular masses, inasmuch as they are not simple minerals.

§. 77. Imitative Shapes arising out of the Geodes of Crystals.

There are three different kinds of imitative shapes resulting from geodes of crystals: 1. Those in which the individuals spring from, or are attached to, a common point

of support; 2. Those in which the individuals form one the support of the other; and 3. Those in which the support is cylindrical, sometimes a simple line, sometimes a tube.

Among those of the first division, we find the *implanted globular shapes*. They arise, if very thin capillary crystals, or in general, such as have one of their dimensions considerably surpassing the others, are fixed with one of their ends to a common point of support, from which they diverge in every direction. The mode of the formation of such globular shapes is more apparent, if the number of the individuals is not so great that they touch each other on all sides. The implanted globules must necessarily be incomplete, because the implanted crystals of which they consist are themselves incomplete, and therefore they leave no impression when detached from their support. Globular shapes of this kind occur very frequently in Stilbite, Gypsum, and Arragonite.

If, during the formation of several globules, they come into contact with each other, there will arise *reniform* and *botryoidal* shapes, which therefore, are nothing else than several implanted globules joined together. The single globules are separated from each other by faces of composition. These compositions are very frequent in Hæmatite, Chalcedony, Wavellite, &c. In some instances, as for example in Chalcedony, the individuals become so delicate as to cease to be any longer observable.

To the present class, belong also the *fruticose* shapes, which possess some resemblance to parts of certain plants, and most of those commonly called *dendritic*, the latter of which may penetrate throughout the whole mass, or only be superficial.

The second division contains among others, the *dentiform*, the *filiform*, and the *capillary* shapes. These arise, if one implanted crystal is the support of another, this of a third and so on; so that rows of such crystals are produced, as may be seen in Native Copper and Native Silver.

Sometimes several rows of individuals thus composed, join within one and the same plane in certain constant directions, so that the individuals of the one of these series do not join with those of the other, but remain separate. Thus the *dendritic* shapes are produced, as seen in Native Silver and Native Gold.

If the rows of individuals, thus arranged, approach so near each other that they at last meet, so as to form a continuous mass, they are said to occur in *leaves* or *membranes;* examples of which are found in Native Gold.

Compound minerals, like those of membranes, may again join in a new composition, in which the individuals are arranged, for the most part, at right angles to each other. This composition is denominated the *reticulated* shape, and is often seen in Titanite.

The third division comprehends the *stalactitic* and *coralloidal* shapes. The first of these consists of individuals which are *perpendicular* to every point of a straight cylindrical or linear support, in its whole circumference. Examples of this composition are common in Carbonate of Lime, in those productions called stalactites: more rarely, in Chalcedony and Iron Pyrites. The coralloidal shapes consist of individuals *inclined* at an angle to their support, which, although linear, is not straight; they are fixed upon this support in every part of the circumference, exactly as is the case in the stalactitic shapes. This kind of imitative shapes is frequently met with in Arragonite.

§. 78. Amorphous Composition.

If the mass, formed by the junction of several individuals, is not only of an irregular shape, but if even in this, we cannot trace any resemblance with the shape of another body, the mineral is said to be massive.

Massive minerals are amorphous, irregular compositions of individuals of the same species, which are in contact with each other on all sides. The difference between massive minerals, and those forms resulting from the groupes of crystals which deviate more or less from the spheroidal shape, consists merely in the strong adhesion of the former to the surrounding masses of other species. It is formed, however, and assumes a shape corresponding to its own inherent powers, and does not depend upon its support, inasmuch as we are led to suppose both of them to be of contemporaneous origin.

Massive minerals, of a smaller size, are also disseminated minerals, which have again been subdivided according to the size of the particles. Very large masses of amorphous minerals sometimes enter into the composition of rocks, as Carbonate of Lime and Gypsum,

&c. Under these circumstances, they assume the shape of beds, veins, &c., the consideration of which forms the province of Geology.

§. 79. Accidental Imitative Shapes.

The accidental imitative shapes presuppose an empty space, which has been filled up by the individuals of compound minerals, to which is transferred the form of the the pre-existing space.

In this case, the shape, which the mineral assumes, is not a consequence of the properties inherent in the mineral, but is due solely to the space in which its formation takes place, the sides of which serve for a support to the individuals. Thus, at first a coating is formed which consists of small, but, in many cases, very perceptible crystals, whose apices are turned towards the inside of the empty space. This accounts for the hollowness of many imitative forms of this kind, of which the cavities are still lined with crystals.

The space, in which the accidental imitative shapes are produced, may be either regular or irregular. A regular space cannot be produced except by crystallization; and this may be either in the interior of a real crystal, or it is the cast of a crystal in the surrounding mass. The first is not uncommon, particularly in large crystals of Quartz, where part of the space of the crystals has remained empty, and is regularly limited by the surrounding crytalline mass.

The irregular spaces sometimes consist of accidental fissures, cracks, and other similar openings; sometimes they depend upon the structure of the surrounding mass; others are derived from the moulds of various minerals, and also of organic bodies.

The different kinds of space above alluded to, produce a distinction of their forms into *regular* and *irregular* accidental imitative forms.

§. 80. Regular Accidental Imitative Shapes.—Pseudomorphoses.

The regular imitative shapes have been called pseudomorphoses, or suppositious crystals.

The denomination of *crystals* to these shapes was, no doubt, first applied from their external regularity; the slightest attention to their internal structure is sufficient to show the impropriety of such a name, since, in this respect, they share so little in the properties of real crystals.

No pseudomorphoses are formed in such impressions as originate from imbedded crystals, and which are disunited on all sides from the surrounding mass. But if an implanted crystal (§. 54,) is covered over by the mass of another mineral, which has been formed after the production of the first, the deposits of new individuals will at first constitute a *coating*, consisting of minute crystals, and through which the form of the implanted crystal still continues to be perceptible; the mineral may yet proceed in its formation, and become massive, or it may assume any other imitative shape, in which, the form of the original implanted crystal entirely disappears. The crystal is moulded in this mass; and, if it be taken away, or decomposed, it will leave an *impression* of its form. Quartz often presents instances of these impressions. From the form of the impression we may very often infer by what mineral it has been occasioned. Thus, what has been called the *ramose* shape of the Meteoric Iron of Siberia, is the result of impressions produced by crystals and grains of Chrysolite.

The crystals sometimes are decomposed in the place of their formation, and compound minerals come in to fill the cavities thus produced; in these cases, the compound mineral assumes the shape of the space already existing, since the sides of this become the support of the newly formed individuals. After this manner, pseudomorphoses are formed, which appear in the shape of implanted crystals, if the mass containing the impressions, by any cause, shall happen to disappear.

All the peculiarities of the pseudomorphoses admit of an easy explanation from the mode of their formation above described.

The form of the pseudomorphoses, has no relation at all to the nature of the mineral in which it occurs. For it is entirely accidental, from what mineral the impression is derived, in which the new individuals have been deposited. Thus in Quartz we meet with forms originating from Carbonate of lime, Fluor and from Gypsum; which is sufficient to prove, that the forms of the pseudomorphoses cannot by any means be members in the series of crystallization of those species to which they belong.

The quality of the surface of the pseudomorphoses, depends only upon its form, and not upon its substance, or its mode of composition,

for the elevations and depressions of the mould are likewise expressed in the cast, which in this case is the pseudomorphosis. The surface sometimes bears a new coating of very minute crystals, of the species of which the pseudomorphoses consists. This is frequent among the pseudomorphoses of Quartz, which affect the form of Carbonate of lime. It is merely accidental however, and therefore not to be classed among the peculiar and constant characters of such productions.

Pseudomorphoses are frequently hollow; and their cavities are lined with crystals, or with reniform and other imitative shapes of that species, which constitutes the pseudomorphoses.

Pseudomorphoses are compound minerals, even though on account of the minuteness of the individuals, the composition should no longer be perceptible. They are also very often mixed, since several species may obviously be deposited in an impression at the same time, in the same way in which several species may enter into the composition of a geode.

Pseudomorphoses cohere immediately with the adjacent mass, and therefore seem only to be implanted.

Mere coatings of crystals must not be included under pseudomorphoses, since the latter are produced by the process of subsequent formation in a mould, as it has been explained above. Nor can it be allowed, to consider decomposed or otherwise destroyed varieties of one species, as pseudomorphoses of another. Thus, the decomposed crystals of red Oxide of Copper, can never become pseudomorphoses of Carbonate of Copper, &c.

The origin of another remarkable appearance, is so nearly related to that of pseudomorphoses, that there is no place more suitable than the present, for its illustration.

Sometimes it happens, that the regular structure of a simple mineral is impressed into the mass of another, which enters into fissures parallel, or dependent upon this structure. If now, the simple mineral, by some accident, is decomposed, the remaining compound one will represent a shape which entirely depends on the structure of the decomposed individuals. The same takes place if the individuals of compound minerals do not cohere from all sides, so that they allow of the interposition of foreign matter. Thus, the *cellular shapes* arise, of which the former have been called *regular*, and the latter *irregular*, cellular shapes. The sides of the alveolæ are also sometimes lined with minute crystals of a third mineral. Thus we find cellular shapes in Quartz, produced by Galena, and whose sides are lined with Iron Pyrites.

The crystals of Steatite are considered as real crystals by some mineralogists, and by others as pseudomorphoses; nothing decisive, as respects this point, has as yet been brought forward.

§. 81. Irregular Accidental Imitative Shapes.

According to the quality of the space, in which these imitative shapes have been formed, they may be distinguished into: 1, those whose form is entirely accidental; 2, those whose form depends upon particular openings in other minerals, which are not simple ones; and 3, those whose form depends upon bodies, not belonging to the mineral kingdom.

In the mass of rocks, and in that of beds and veins, we very often meet with cracks and fissures, which seem to have once been open, or which still continue so. Commonly, this appearance is explained by supposing them to be real fissures, or that the coherence of the particles in the rocky mass has, in their case, been overcome, by some means or other. If a mineral is formed in a fissure of that kind, it must necessarily assume its form; and the mineral, appearing in this shape, is said to occur in *plates*. These fissures are sometimes so very narrow, that a fluid can scarcely enter between their sides; a mineral formed in such a space is said to occur *superficial*, which in fact is nothing else than a very thin plate.

There are instances where the sides of these fissures are nearly even, and possess a certain degree of polish. Fissures of this description very seldom seem to have been filled up with other minerals; on the contrary, the sides are in immediate contact with each other. The sides of such fissures are said to be *specular*.

Several rocks contain vesicular cavities. In these cavities minerals are formed, which consequently must assume their shape, and appear as more or less spheroidal masses. Such globules very often consist of the varieties of more than one species, and are sometimes hollow inside. They must be accurately distinguished from the grains, (§. 54.) and from the globules described above. (§. 77.) Examples of this kind exist in Agate Balls, Quartz, &c.

If this kind of globular concretion is not hollow inside, and at the same time very irregular, so as to exhibit some resemblance to

the roots of certain plants, the forms arising, are called *tuberose*, of which Flint is one of the most common examples.

To this class also, we must refer the irregular cellular shapes. (§. 80.) These distinctions are of little or no importance, for the most part, as characters for the recognition of minerals; though necessary to be understood, to prepare the pupil for the full description of the species, where it is intended that the descriptions shall convey as complete a picture as possible of every individual included under each species.

Those shapes which depend upon forms foreign to the mineral kingdom, are the *petrifactions*. There is no difference between the formation of the greater part of petrifactions, and of the pseudomorphoses, or the accidental imitative forms, and it does not therefore require any particular explanation. *Mineralized* organic remains cannot be classed among real petrifactions. These are not formed like pseudomorphoses, in which the space left empty by the decomposition of one body is filled up by another, but the organic mass is metamorphosed or changed into that of the mineral. Mineralized organic bodies, besides their original shape, may also retain their original structure, as numerous varieties of Mineral Coal.

Several minerals, even after their formation, assume other forms, which are accidental. Such are *pebbles*, formed when fragments of minerals are carried along by water, until, by attrition, they acquire a more or less rounded shape. Simple, compound and mixed minerals, are found in the shape of pebbles.

§. 82. Particles of Composition.

The individuals of which a compound mineral consists are called its Particles of Composition.

The particles of composition are true crystals, which, by their contact, have prevented each other from assuming their regular form.

The particles of composition have also been called *Distinct Concretions*. The other expression, however, is preferable, since it shows their reference to compound minerals, whereas distinct concretions may also allude to simple minerals.

The particles of composition are distinguished according to their length, breadth, and thickness, into *granular*, *columnar*, and *lamellar*, particles of composition. The granular particles have all their

dimensions nearly equal, or at least not very different. In the columnar particles, the length is greater than both breadth and thickness; and in direction, they are either parallel or diverging. In the lamellar particles, the length and breadth surpass the thickness. There are straight and curved lamellar particles of composition. The latter are not individuals, but are composed already of themselves. Examples, of the first of these kinds, occur in Coccolite, (a variety of Augite,) and Colophonite, (a variety of Garnet,) of the second in Pycnite, (a variety of Topaz,) and in Arragonite; and of the last in Tabular Spar, and Slate Spar, (a variety of Carbonate of Lime.)

The size of the particles of composition varies considerably. Sometimes they are so minute as scarcely to be observable. Yet minerals, in which they are discoverable with difficulty, and even others in which we are unable to detect them at all, may be shown to be compound minerals. This may be illustrated by a reference to a series of specimens of Galena. In one of them, the particles of composition shall be of such distinctness as immediately to be visible to the naked eye; a second will present them smaller, and a third still more diminished; a fourth, fifth, &c. may be conceived of, regularly decreasing; and at length, we arrive at one in which the naked eye fails to discover the compound character. But a microscope renders it apparent. Other specimens, still more compact, will exhibit particles of composition only in particular places, even when observed by the microscrope. From these observations, we cannot avoid the conclusion, that these specimens are all varieties of the same mineral, and that they differ merely in the size of their constituent individuals. And, when we find specimens thus connected, those in which the composition ceases to be observed are still to be regarded as compound.

The columnar and lamellar particles are exactly in the same case. The former are very obvious in the stalactitic and reniform shapes of Hæmatite; but in the compact varieties of this mineral they wholly disappear. Of this vanishing, and almost impalpable composition, we have good examples in the reniform and stalactitic shapes of Chalcedony and Gibbsite, in whose specimens, in general, we can discover no trace of composition, but others do nevertheless occur, of these minerals, in which the composition is visible.

§. 83. Single and Multiple Composition.

The single composition takes place, if a compound mineral consists of individuals; but if the particles of composition are again composed, then the composition is multiple.

The compositions, treated of in the preceding articles, are single compositions.

But there exist particles of composition, which are again composed of granular particles, which last only, are real individuals. They join into those masses which again, on a larger scale, produce a granular composition. Thus, in Dolomite we sometimes have granular particles, consisting of columnar particles; and in Carbonate of Lime and in Chalcedony, columnar particles are observed consisting again of columnar individuals.

§. 84. Characteristic Marks of Composition.

Imitative shapes, and the want of cleavage, are the chief characters, from the presence of which composition may be inferred, if this should not be observable at first sight.

An individual formed under such circumstances as lie beyond the reach of foreign influence, will always assume a regular form. If, therefore, we meet with minerals which evidently have not been acted upon by any such circumstances, and which nevertheless do not present any regular form, we may infer, with perfect security, that the mineral is not a simple one, but that it is a compound of several individuals.

With regard to the accidental imitative shapes, it is evident, that not even those which are regular can be the forms of simple minerals, because they are altogether accidental; whereas the forms of simple minerals are founded in the nature of the individuals themselves. Hence the imitative shapes, of whatever kind they may be, are, in every instance, infallible characters from which the composition of the minerals may be inferred. But we could suppose that a compound mineral might consist of particles in a perfectly parallel position, but so small that the composition can no longer be observed, so that the directions of cleavage of the single particles, or supposed individuals in one of them are the continuation of those in

the other. In this case the whole mass will be cleavable, and the whole will therefore, be a single individual, and not a composition agreeably to the definition in (§. 70.) Hence cleavable minerals are simple; and the want of cleavage in varieties of such species as commonly allow of cleavage, is a mark of their composition; because here one individual assumes a situation different from that of another, so that their respective faces of cleavage can have no continuity among one another. For this reason, compact Limestone, compact Fluor, and compact Heavy Spar are not cleavable, although the simple varieties of the same species may be cleaved with the greatest facility.

The same applies to the pseudomorphoses.

Among the other characters of composition, we may mention, that compound minerals in which the composition can no longer be observed, are most intimately connected in all their properties with those in which it is still visible, and that commonly they possess lower degrees of transparency and lustre, than simple varieties of the same species. Examples illustrative of the present remark may be seen among specimens of Quartz, Carbonate of Lime and Galena.

The following observations will furnish characters in most cases sufficient for distinguishing mixed and compound minerals, in both of which, the particles disappear on account of their minuteness.

The different ingredients of the mixture are sometimes found separated from the rest in more or less pure masses, by which the mixture ceases to be uniform. If we find an opportunity for observing mixed masses of this kind, on a larger scale, we may very often find those particles entirely disengaged, or separated from each other, as is the case with Hydrous Oxide of Iron, and Quartz in the original repositories of *Iron flint*, which is an intimate mixture of these two species. Thus, we infer Basalt to consist of Feldspar and Augite, or Hornblende, because Greenstone and the Syenitic rocks in which the particles of mixture have more extension only, really do consist of the above mentioned species, and differ from common Basalt merely by their coarser grain.

Moreover, the mixed minerals partly possess the properties of the one, partly also those of the other, of the simple minerals of which they consist, without entirely agreeing with any of them, as, for instance, Iron flint, which possesses some of the properties of Quartz, &c., or they assume such properties as never occur in simple minerals; as, for instance, the columnar shapes of Basalt, of Porphyry, and the singular forms of Greenstone, which, by themselves, prove

these minerals to be compound, even though the component individuals should no longer be perceptible.

§. 85. Structure of Compound Minerals.

That kind of fracture which has been considered as belonging to simple minerals, does not occur in compound minerals. In breaking these last, however, we produce what has been called their Fracture; and the particles of the mineral separate in the Faces of Fracture.

If the particles are still distinguishable as individuals, they must be considered according to their respective regular or irregular structure, to their faces of composition, and to every other character which they present to the observer; in short, they must be considered as simple minerals. In the present place, therefore, only those compound minerals will be treated of, in which on account of their minuteness, the individuals are no longer distinguishable. In these, the following kinds of fracture have been distinguished.

1. The *Conchoidal Fracture*, together with its various modifications, which depend upon size, perfection, relative depression, &c. (§. 69.)

2. The *Uneven Fracture*, which has been subdivided according to the size of the asperities, into coarse-grained, small-grained, and fine-grained uneven fracture.

3. The *Even Fracture*, which arises, if the elevations and depressions upon the face of separation nearly approach to evenness. These even parts of the fracture must not be confounded with faces of cleavage, because they do not keep a constant direction, and are only observable in compound minerals. This variety of fracture is not common.

4. The *Splintery Fracture*, which is produced, if upon the face of separation, detached scaly particles remain, joined to the mass by their thicker end. These particles are rendered visible by that portion of light which passes through them; and the splintery fracture, therefore, does not occur in perfectly opaque minerals. It may occur at the same time with the conchoidal, or another kind of fracture.

5. The *Hackly Fracture* has been sufficiently explained in §. 69.

6. The *Slaty Fracture* resembles imperfect faces of cleavage, and partly arises from it. It is met with in the different kinds of *Slate*, which, for the greater part, are compound minerals, or even mixed, although they appear to be simple. The slaty fracture keeps a constant direction, and is in this respect analogous to cleavage.

7. The *Earthy Fracture* is the same as the uneven fracture, except that it occurs in decomposed minerals.

SECTION III.

THE NATURAL PROPERTIES, COMMON TO BOTH SIMPLE AND COMPOUND MINERALS.

§. 86. Division.

Those Natural properties, which are common to both the simple and the compound minerals, may be divided into the Optical Properties, and into the Physical Properties of minerals, or such as refer more particularly to their mass or substance.

Optical characters are such as depend upon light, and are not observable except in its presence. They include *lustre*, *color*, and *transparency*.

The physical properties of minerals, comprehend all those which neither depend upon their form, and the space which they fill up, nor upon the presence or absence of light. Of these are the following, the *state of aggregation*, *hardness*, *specific gravity*, *magnetism*, *electricity*, *taste* and *odor*.

OF THE OPTICAL CHARACTERS OF MINERALS.

§. 87. Lustre, Color, Transparency.

The phenomena observable in minerals, with respect to reflected and transmitted light, are comprehended under the heads of *Lustre*, *Color*, and *Transparency*.

These subjects are treated of in mineralogy, only so far as they allow of some application in discriminating and describing minerals. In order to employ them to any purpose, it is necessary to determine and to provide with peculiar denominations, those differences which may be distinguished in these properties, both in respect to their kind and intensity. This will require us to fix a certain impression upon our mind, and always to designate this impression with the same name, so as to recall it to our memory, whenever we read this name, or hear it uttered. It is necessary therefore to have experienced these impressions upon our own mind, since explanations cannot be substituted in their place. An acquaintance with these properties may be acquired from the consideration of bodies, which are not minerals. But it is best and most easily obtained by addressing ourselves to the bodies themselves. The pupil is therefore advised to familiarize his mind with the distinctions detailed under the present characters, by an attentive examination of a collection of specimens arranged expressly for their illustration.

In the determination of species, the present characters are rarely of much value; but in descriptive mineralogy, where the business is not to distinguish objects, but to produce an image of them, the optical properties of minerals are not inferior in importance to any other properties.

The optical characters must therefore, by no means, be neglected, although many of them are of less importance than those derived from the forms to the progress of mineralogy. Very often by their assistance, the pupil may dispense with the use of the characteristic, because they are very well calculated for recalling to his mind such varieties of the same species as he has before determined. They are obvious at first sight, and are capable of being observed and determined under whatever circumstances they may be found.

§. 88. Kinds and Intensity of Lustre.

The lustre of minerals is considered in respect to its *kind*, and in respect to its *intensity*.

The kinds of lustre are:

1. Metallic lustre,
2. Adamantine lustre,
3. Resinous lustre,
4. Vitreous lustre,
5. Pearly lustre.

The *Metallic Lustre*, is subdivided into *perfect* and *imperfect*, metallic lustre. The first of these occurs in the pure metals, their alloys, and occasionally in their oxides and combinations with sulphur, as in Galena and Iron Pyrites; the second is found in the oxides of the metals for the most part, and is particularly exemplified in Columbite.

The *Adamantine Lustre*, is subdivided into *metallic* adamantine, and *common* adamantine. The common adamantine is nearly peculiar to the Diamond; the metallic adamantine is found in Red Silver ore and some varieties of Carbonate of Lead.

The *Resinous Lustre* is well understood from our knowledge of it in Resin. It may further be defined as presenting the appearance of a body besmeared with oil or fat. It is best seen in Pitchstone.

The *Vitreous Lustre* is that of glass, and may be observed in common Quartz.

The *Pearly Lustre* is divided into *common* and *metallic*, pearly lustre. The first which approaches the nearest that of the pearl, is found in Heulandite, Stilbite, and some varieties of Mica: the second occurs in Bronzite and Hyperstene.

As to the intensity of lustre, the following degrees are distinguished:

1. Splendent,
2. Shining,
3. Glistening,
4. Glimmering,
5. Dull.

Splendent, applies to those faces which possess the highest degree of lustre; and which produce distinct and well defined images, of external objects, provided they are of sufficient dimensions and evenness. Such faces are contained in Garnet, Blende, Tin ore, &c.

Shining, is the next less degree of lustre; it does not produce reflections equally distinct. Calcareous Spar, and Sulphate of Barytes often present examples of it.

Glistening, is that in which the light is reflected still less distinctly; but though it does not yield an image, it reflects it in pretty well defined patches. This degree of lustre is found in most of those compound minerals in which the particles of composition are still observable. Examples are Copper Pyrites, and Grey Oxide of Copper.

Glimmering does not reflect defined patches of light, but a mass of undefined light seems spread over the glimmering surface. This

degree of lustre is observable in the columnar composition, (often called fibrous fracture,) and in other compound minerals in which the composition is no longer observable, as in the varieties of Quartz called Hornstone, Flint, and Chalcedony. This degree of lustre may generally be taken as a sign of a compound mineral, the individuals of which are so very small, as nearly to disappear. It is produced by the reflection of light, from every one of the impalpable component parts.

Dull, possesses no lustre at all. This perfect absence of lustre is almost entirely confined to decomposed minerals, as in Kaolin.

§. 89. Series in the Differences of Lustre.

In general, neither the kinds nor the degrees of lustre admit of rigorous limits. It is necessary to determine them in some particularly distinct examples, and to compare with them such as are less distinct.

If there occur several kinds or degrees of lustre in the varieties of a species, these will be in an uninterrupted connexion, and they will pass insensibly into one another, so that in no place are we capable of observing any interruption or want of continuity. Out of the succession in these gradations, the series in question arises.

If we make abstraction of what is merely accidental, similar faces in single individuals agree as to the kind and degree of intensity of their lustre; and, on the contrary, such faces as are not similar, disagree in this respect. This is equally the case as relates to faces of crystallization, and to faces of cleavage, as is shown by examples from Gypsum, Mica, and Stilbite. Pearly lustre is the most remarkable among the different kinds; since, in a high state of perfection, it appears in simple minerals only upon single faces of crystallization as well as of cleavage: example, Heulandite.

§. 90. Division of Colors.

The colors are divisible into two series: 1. The *metallic colors*; 2. The *non-metallic colors*.

For the better distinction of colors, Werner was led to assume eight principal colors as the foundation of all the others. These

are, *White*, *Grey*, *Black*, *Blue*, *Green*, *Yellow*, *Red*, and *Brown*. Each of these comprehends several varieties, the names of which are either derived from such bodies as they most frequently occur in, or they are formed by composition. Examples of the first are, *rose-red*, *apple-green*, &c.; of the latter, *reddish-brown*, *yellowish-brown*, &c.

§. 91. Metallic Colors.

The metallic colors are, 1. Copper-red; 2. Bronze-yellow; 3. Brass-yellow, and 4. Gold-yellow; 5. Silver-white, and 6. Tin-white; 7. Lead-grey, and 8. Steel-grey, and 9. Iron-black.

1. *Copper-red*, the color of metallic copper. Ex. Native Copper.
2. *Bronze-yellow*, the color of several metallic alloys, as Bronze and Speise. Ex. Magnetic Iron Pyrites.
3. *Brass-yellow*, the color of brass. Ex. Copper Pyrites.
4. *Gold-yellow*, the color of pure gold. Ex. Native Gold.
5. *Silver-white*, the color of pure silver. Ex. Native Silver.
6. *Tin-white*, the color of pure tin. Ex. Native Antimony and Native Mercury.
7. *Lead-grey*, the color of metallic lead. Ex. Galena, and Sulphuret of Molybdena.
8. *Steel-grey*, approaching the color of recently fractured steel. Ex. Native Platina, and Graphic Tellurium.
9. *Iron-black*, nearly the color of cast-iron. Ex. Octahedral Iron Ore.

§. 92. Non-Metallic Colors.

The non-metallic colors are considered in the order in which the fundamental colors have been enumerated in §. 90.

The following are the non-metallic colors.

(A.) *White.*

1. *Snow-White.* The purest white color. Ex. Carrara Marble and Flos-ferri.
2. *Reddish-white.* White with a tinge of red. Ex. Some varieties of Calcareous Spar and of Quartz.

3. *Yellowish-white.* White, inclining to yellow. Ex. Varieties of Calcareous Spar and of Opal.

4. *Greyish-white.* White inclining to grey. Ex. Quartz.

5. *Greenish-white.* White mingled with a shade of green. Ex. Asbestus and Talc.

6. *Milk-white.* White bordering on blue; the color of newly skimmed milk. Ex. Quartz and Opal.

(B.) *Grey.*

1. *Bluish-grey.* Grey with a slight tinge of blue. Ex. Quartz and Limestone.

2. *Pearl-grey.* Grey with an intermixture of blue and red. Ex. Porcelain Jasper.

3. *Smoke-grey.* Grey mixed with brown; the color of dense smoke. Ex. Quartz.

4. *Greenish-grey.* Grey mixed with green. Ex. Talc.

5. *Yellowish-grey.* Grey mixed with yellow. Ex. Limestone.

6. *Ash-grey.* The purest grey color; a mixture of white and black. Ex. Zoisite.

(C.) *Black.*

1. *Greyish-black.* Black mixed with grey. Ex. Basalt and Anthrakolite.

2. *Velvet-black.* The purest black color; the color of black velvet. Ex. Obsidian.

3. *Greenish-black.* Black mixed with green. Ex. Augite.

4. *Brownish-black.* Black mixed with brown. Ex. Anthracite.

5. *Bluish-black.* Black mixed with blue. Ex. Black Cobalt.

(D.) *Blue.*

1. *Blackish-blue.* Blue mixed with black. Ex. Dark colored varieties of Blue Malachite.

2. *Azure-blue.* A bright blue color mixed with a little red. Ex. Pale varieties of Blue Malachite.

3. *Violet-blue.* Blue mixed with red. Ex. Amethyst.

4. *Lavender-blue.* Blue with a little red and a considerable grey. Ex. Clays.

5. *Plum-blue.* A color peculiar to certain varieties of plums. Ex. Spinelle.

6. *Prussian-blue,* or Berlin-blue. The purest blue color. Ex. Sapphire and Cyanite.

7. *Smalt-blue.* The color of a pale variety of Smalt. Ex. Anhydrite.

8. *Indigo-blue.* Blue mixed with black and green; the color of Indigo. Ex. Blue Iron Earth.

9. *Duck-blue.* Blue largely mixed with green and a little black. Ex. Talc.

10. *Sky-blue.* A pale blue color, with a little green; the color of the clear sky. Ex. Fluor.

(E.) *Green.*

1. *Verdigris-green.* A green color, inclining to blue; the color of verdigris. Ex. Green Feldspar.

2. *Celandine-green.* A green color mixed with blue and grey. Ex. Beryl

3. *Mountain-green.* Green with much blue. Ex. Aqua-marine.

4. *Leek-green.* The color of the leaves of garlick. Ex. Prase.

5. *Emerald-green.* The purest green color. Ex. Emerald.

6. *Apple-green.* A light green color with a shade of yellow. Ex. Chrysoprase.

7. *Grass-green.* The lively color of grass in the spring; green mixed with much yellow. Ex. Green Diallage, Actynolite, &c.

8. *Pistachio-green.* Green with yellow and brown. Ex. Chrysolite and Epidote.

9. *Asparagus-green.* Pale green, with much yellow. Ex. Asparagus stone.

10. *Blackish-green.* Green with black. Ex. Serpentine.

11. *Olive-green.* Pale green, with much brown and yellow. Ex. Pitchstone.

12. *Oil-green.* A green color still lighter, with more of yellow, and less of brown; the color of olive oil. Ex. Blende.

13. *Siskin-green.* A light green color, very much inclining to yellow. Ex. Uranite.

(F.) *Yellow.*

1. *Sulphur-yellow.* The color of pure sulphur. Ex. Native Sulphur.

2. *Straw-yellow.* Light yellow; nearly the color of straw. Ex. Karpholite.

3. *Wax-yellow.* Yellow with grey and a little brown; the color of yellow wax. Ex. Common Opal.

4. *Honey-yellow.* Yellow with a little red and brown; the dark color of honey. Ex. Fluor.

5. *Lemon-yellow.* The purest yellow color; the color of ripe lemons. Ex. Yellow Orpiment.

6. *Ochre-yellow.* Yellow with brown. Ex. Iron Flint.

7. *Wine-yellow.* A pale yellow color, with a little red and grey; the color of several sorts of white wine. Ex. Topaz and Fluor.

8. *Cream-yellow.* A pale yellow color; the color of cream; rare. Ex. Molybdate of Lead.

9. *Orange-yellow.* Yellow, inclining to red; the color of ripe oranges. Ex. Orpiment.

(G.) *Red.*

1. *Aurora-red.* Red with much yellow. Ex. Red Orpiment.

2. *Hyacinth-red.* Red with yellow and brown. Ex. Hyacinth.

3. *Brick-red.* Red with yellow, brown and grey; the color of freshly baked bricks. Ex. Jasper.

4. *Scarlet-red.* The brightest red color. Ex. Cinnabar.

5. *Blood-red.* The color of blood. Ex. Garnet.

6. *Flesh-red.* A pale red color. Ex. Feldspar.

7. *Carmine-red.* The purest red color; the color of carmine; rare. Ex. Oriental Ruby, capillary red Oxide of Copper.

8. *Cochineal-red.* Red with a little blue and grey. Ex. Garnet.

9. *Rose-red.* A pale red color, mixed with white; the color of the flowers of the *Rosa centifolia.* Ex. Rose Quartz and red Manganese Ore.

10. *Crimson-red.* Red with a little blue; a very fine color. Ex. Oriental Ruby.

11. *Peach-blossom-red.* Red with white and grey; the color of peach-blossoms. Ex. Lepidolite.

12. *Columbine-red.* Red with a little blue and much black. Ex. Garnet.

13. *Cherry-red.* A dark red color. Ex. Spinelle and red Sulphuret of Antimony.

14. *Brownish-red.* Red with much brown. Ex. Hæmatite.

(H.) *Brown.*

1. *Reddish-brown.* Brown mixed with much red. Ex. Zircon.

2. *Clove-brown.* Brown with red and a little blue. Ex. Axinite.

3. *Hair-brown.* Brown with a little yellow and grey. Ex. Agatized wood.

4. *Broccoli-brown.* A brown color mixed with blue, red and grey; rare. Ex. Zircon.

5. *Chesnut-brown.* The purest brown color. Ex. Egyptian Jasper.

6. *Yellowish-brown.* Brown with much yellow. Ex. Iron Flint and Jasper.

7. *Pinchbeck-brown.* Yellowish-brown with a metallic lustre. Ex. Talc, and Hypersthene.

8. *Wood-brown.* Brown with yellow and much grey. The color of old wood. Ex. Mountain wood.

9. *Liver-brown.* Brown with grey and a little green. Ex. Common Jasper.

10. *Blackish-brown.* Brown with much black. Ex. Bituminous coal.

The colors above mentioned represent so many fixed points, between which there exist in nature numerous shades. These are indicated by the two with which they best agree. If the color, in a given case, differ but little from one of these standards, it is said to be that color, only *inclining* or *passing* into another.

Colors may be different in their intensity, though belonging to one and the same variety. Differences of this kind are indicated by the expressions *pale, light, deep, dark.*

§. 93. Series of Colors.

The varieties of color occurring in the individuals of one and the same species, form an uninterrupted series, which is called the *Series of Colors of that Species.*

All the species in mineralogy are not equally complete in this respect. Many offer but few varieties of color, while others present us with a very great number. In these last, it is observable, that they insensibly pass into each other, or that every one of them is intermediate between two others. Thus they represent an uninterrupted succession of the shades of colors, and give rise to what is meant by the series of colors.

The series of colors cannot be described; they must be studied from nature. An idea of them, however, is soon, and very easily obtained by the examination of a few species very complete in this particular, and which are arranged expressly for this end. The following are among the most eligible for the purpose; Quartz, Tourmaline, Mica, Fluor, Corundum, and Spinelle.

§. 94. Peculiarities in the Occurrence of Colors.

There exist several peculiarities in the occurrence of colors among minerals, which, though from their want of

constancy, are not very serviceable in mineralogy, are nevertheless, exceedingly interesting. They have been called the *Play of Colors*, the *Change of Colors*, the *Opalescence*, the *Iridescence*, the *Tarnish*, and the *Delineations of Colors*.

The only use made of these properties is in the descriptive part of Natural History.

1. The *Play of Colors* is produced, if the mineral reflects, in certain directions, other colors beside its own, and these, for the most part, rainbow colors of very unusual brightness and intensity. They are not steady, or always observable in the same place, but alter with the position of the mineral, or with the direction of the rays of light. It is witnessed in the highest perfection in the Diamond when cut: and depends in this gem upon the reflexion of refracted light, occasioned by the artificial facets. The precious Opal presents the same phenomenon, even before being cut. Candle light, or sunshine is much more advantageous for the display of this effect than the ordinary light of day.

2. The *Change of Colors* consists in the reflexion of bright hues of color in certain directions, depending upon the structure of the mineral. It covers larger spots than the play of colors, and they do not disappear so rapidly on being moved. It is best seen in the Labrador Feldspar.

3. The *Opalescence* consists in a kind of milky light, which certain minerals reflect, either when cut or in their natural condition. It occurs in the Cats-eye, where it depends upon composition,—this substance consisting of Quartz traversed by delicate fibres of Asbestus: also, in Chrysoberyl and Feldspar, (var. Adularia) in both of which it depends upon the crystalline structure; as also in the Sapphire in which it appears in the six-rayed stars of light, and has received the name of Asteria.

4. The *Iridescence* shows the colors of the rainbow, similar to those produced by the refraction of light, through a prism of glass. It depends upon fissures in the interior of minerals. The cavities present the phenomenon of the colored rings. It is most striking in Quartz.

Another remarkable property of certain minerals is, that they show *different colors*, if examined by transmitted light in certain directions. This property of minerals has been termed their *Di-*

chroism. Tourmaline, Iolite and Mica are among the most distinct examples. Several varieties of the first are nearly opaque in the direction of the axis, while they show different degrees of transparency, and various colors, as green, brown and blue, in a direction perpendicular to it. Mica is often green in the direction of the axis and brown perpendicular to this line. The application of this property is greatly extended by examining minerals in polarized light, where many minerals show dichroism, which exhibit in common light, the same color in every direction.

5. The *Tarnish* consists in the alteration of the color of a mineral upon its surface. It is useful to attend to this peculiarity of minerals (common only to such as have a metallic lustre) in order to avoid confounding it with their real colors, which are discoverable only by effecting a fresh fracture. It is frequent in Copper Pyrites.

6. Simple minerals very seldom present more than one color at a time. Instances occur, however, where the same crystal exhibits two or more, as the red and green in Tourmaline, and the white and purple in Fluor. Compound minerals, on the contrary, are frequently variegated, and the *Delineation of Colors*, refers to the figures which the different colors produce. With regard to these, it is unnecessary to enter into detail. With regard to the *dendritic* delineations, it must be recollected, however, that they are real imitative forms, (§. 77.) and that, therefore, they do not refer to the mineral upon which they are found: they may be only superficial, or be distributed throughout the whole mass of the specimen.

§. 95. The Streak.

If we scratch a mineral with a sharp instrument, either a powder will be produced, or the scratched place assumes a higher degree of lustre. Both these phenomena are included under the term *streak*.

The lustre is heightened by the streak in malleable minerals, as also with clay and several other decomposed minerals.

The best method for observing the color of the powder, is to rub the mineral upon a plate of porcelain biscuit, or upon a file, until the powder appears. In those minerals which are too hard for a process of this kind, the streak is of little importance.

Some minerals retain their color in the streak; others change it. Among the former are most of those minerals which possess a white

color; of the latter are ores of the metals, for the most part, as Hæmatite, which changes from reddish brown to red, and Columbite, which changes from black to reddish brown. The former are said to be unchanged in the streak; of the latter, the alteration of the color in the streak is indicated. A white or grey streak of minerals is said to be uncolored.

§. 96. Degrees of Transparency.

The relative quantity of light which is transmitted through the substance of minerals constitutes the degrees of transparency.

The use of the degrees of transparency is limited to the descriptive part of Mineralogy.

These degrees are,

1. *Transparent*, if the light is transmitted in sufficient quantity to enable us to distinguish small objects placed behind the mineral. Ex. Quartz crystals.

2. *Semi-transparent*, if it is possible to see an object behind the mineral, without, however, being able to distinguish more of it than its general figure. Ex. Smoky Quartz.

3. *Translucent*, if the light every where pervades the mineral, so as to give it an uniform milky appearance, without, however, permitting objects to be perceived through it. Ex. Chalcedony.

4. *Translucent on the edges*, when the above is only true of the sharp edges of the mineral; the main mass remaining perfectly dark. Ex. Hornstone and Jasper.

5. *Opaque*, if a mineral transmits no light at all. Ex. The native metals.

Minerals of a non-metallic character are but very rarely entirely opaque. Yet accidental impurities influence so much their transparency, that this property becomes almost entirely useless for the determination of minerals. The best employment to be made of it, seems to be, in the distinction of compound varieties from simple ones, where the minuteness of the particles of composition prevents them from being observed immediately. Commonly, in the same species, the compound varieties possess a less degree of transparency than the simple ones. This is well exemplified in the varieties of Quartz. Almost all its single individuals, provided they are not impure, shew higher degrees of transparency than Flint, Hornstone and Chalcedony, and other compound varieties.

THE PHYSICAL PROPERTIES OF MINERALS.

§. 97. State of Aggregation.

In respect to the mode of aggregation, minerals, in the first place, are either *solid* or *fluid*. The former are either *brittle*, or *sectile*, or *malleable*, or *flexible*, or *elastic;* the latter are either *liquid* or *expansible*.

A solid mineral is said to be,

1. *Brittle*, if in detaching small particles of it with a knife or a file, these particles lose their coherence, and separate with a grating noise, in a powder. Ex. Quartz, Feldspar and Iron Pyrites.

2. *Malleable*, if the particles detached by the knife do not lose their connexion, but rather separate in slices. Ex. Native Silver, Native Gold and Native Copper.

3. *Sectile*, if the particles, on their separation, as above, merely lose their connexion, without flying off in powder. Sectile minerals are intermediate between brittle and malleable minerals. Ex. Talc and Gypsum.

4. *Ductile*, if it can be wrought into sheets or wire; so that, by the application of a greater or less force, the particles of the mineral may change their relative situation, without absolutely losing their connexion. Ex. Native Gold and Native Silver.

5. *Flexible*, when the particles allow of being bent in different directions without breaking, and remain in the direction in which they have been bent. Ex. Talc and Sulphuret of Molybdena.

6. *Elastic*, if the particles on being bent out of their natural position, resume their former situation when the disturbing force is removed. Ex. Mica.

A fluid is more particularly said to be,

1. *Liquid*, if in pouring it out from a vessel, perfectly round drops are formed. Ex. Water and Mercury.

2. *Viscid*, if the drops are not round, but ropy. Ex. Petroleum.

Expansible minerals do not shew any difference in these respects. They comprehend the Gases and some of the Acids.

It is evident that all these properties are subject to slight variations, and that they must pass into each other by insensible gradations.

§. 98. Hardness.

Hardness is the resistance of solid minerals to the displacement of their particles, the magnitude of which constitutes their *degree of Hardness.*

The character now under consideration is one of the most important possessed by minerals, for the purposes of their determination. We have not, hitherto, been able to ascertain the positive hardness of minerals, from the difficulty of establishing an accurate scale for the degrees of hardness. All the means we at present possess, for arriving at this end, consist merely in the general comparison of the known with the unknown.

The existence of differences in the degrees of hardness among minerals, is very easily ascertained, by the simple experiment of scratching one of them by the other. Thus, a sharp angle of Quartz will produce a deep furrow in Calcareous Spar; whilst a sharp corner of the latter species does not injure the surface of the former. Accordingly, we conclude that Quartz is harder than Calcareous Spar; and, in general, that of two minerals, the harder one scratches the other, but cannot, inversely, be scratched by it.

By proceeding upon this principle, a scale for the degrees of hardness has been made out, which possesses sufficient accuracy for the purposes of mineralogy. This is effected by choosing a certain number of suitable minerals, and arranging them in such an order that every preceding one is scratched by that which follows it, while the latter does not scratch the former.

The scale is as follows:

1. *Talc.* The common green or greenish white varieties.
2. *Gypsum.* An uncrystallized variety. This degree of hardness is exactly that of Rock Salt, which mineral, therefore, may be substituted for Gypsum, in the determination of hardness, or it may assist in the selection of the proper variety of Gypsum to be employed as a term of comparison.
3. *Calcareous Spar,* or a cleavable variety of Carbonate of Lime. Bitter Spar cannot be employed as a substitute, its hardness being somewhat greater than Calcareous Spar.
4. *Fluor.* Any cleavable variety.
5. *Apatite.* Crystals possessing a conchoidal fracture.
6. *Feldspar.* A cleavable variety of Adularia.
7. *Quartz.* Limpid and transparent.

8. *Topaz.* In crystals.
9. *Corundum.* The easily cleavable varieties.
10. *Diamond.*

The minerals representing the units of this scale, have been chosen among those species which may be most readily obtained. It will be perceived, however, that the intervals between the members of the scale are not every where of the same magnitude. Diamond is evidently much harder, if compared with Corundum, than Fluor with Calcareous Spar. This however leads to no inconvenience, in the case above mentioned; for there exists no mineral of a hardness intermediate between the degrees represented by the two first of these species. The interval between Fluor and Feldspar is also greater than it should be; and, in this case, it would be desirable to have another mineral to substitute for Fluor, whose hardness should be such as to divide more equally the interval between Calcareous Spar and Feldspar. Still, with these imperfections, the scale is used to the highest advantage. The degrees of hardness are expressed by means of those numbers, which, in the above enumeration, are prefixed to them. Thus, the hardness of Feldspar is $=6$, that of Corundum $=9$.

The intervals between each two subsequent members may be divided into *ten* equal parts; and these tenths determined by estimate. It will very seldom be required to value the hardness to more or less than 0.5; but it will always be possible to proceed so far as we find it necessary to answer our purpose.

The state of liquidity may be considered as the *zero of the scale.*

If, in employing the scale, we endeavor to find the degree of hardness of a given mineral, by trying which member of the series is scratched by it, and which of them injures the surface of the given one, it will appear that the specimens employed, should possess certain properties, in many cases difficult to be found. They should all have faces perfectly smooth and even, and solid angles or corners of the same form, and be equally hard.

As to the faces, those produced by cleavage seem the most eligible, if they possess a pretty high degree of perfection. Faces of crystallization are commonly uneven or streaked; cut and polished faces, however, in many instances, shew a less degree of hardness than the mineral really possesses.

It is still more difficult to obtain the corners with the constant quality which is requisite. Even in a determined form, these are sometimes liable to be so much influenced by structure, that they give very uncertain results. In this respect, the solid angles of the

Tetrahedron, and those of the octahedron of Fluor, shew quite different results. The corners of compound varieties, in which the individuals become impalpable or disappear, such as Chalcedony, Flint, and others, are commonly found very powerful, much more so than the similarly formed corners of simple varieties. But if the composition is still observable, the particles very often separate in the experiment of scratching another mineral, and the corner of a compound mineral cannot produce the effect of that of the simple mineral. The application of the edges is subject to similar difficulties.

But the experiment of merely scratching one substance by another, has been found not to lead to the most accurate determination of the hardness of minerals. This is powerfully assisted by having recourse to a *file*, in the manner presently to be described.

If we take several specimens of one and the same mineral, and pass them over a fine file, we shall find, that an equal force will every where produce an equal effect, provided, that the parts of the mineral in contact with the file be of similar size, so that the one does not present to the file a very sharp corner, while the other is applied to it by a broad face. It is necessary also, that the force applied in this experiment, be always the least possible. Every person, however little accustomed, will experience a very marked difference, if comparatively trying in this way any two subsequent members of the above scale, and thus, the difference in their hardness will be easily perceived. A little practice is sufficient for rendering these perceptions more delicate and perfect, so that in a short time, it is possible to determine differences in the hardness very much less those between two subsequent members of the scale.

Upon this is founded the application of the scale; the general principle of which consists in this, that the degree of hardness of the given mineral is compared with the degrees of hardness of the members of the scale, not immediately, by their mutual scratching, but mediately *through the file*, and determined accordingly.

The process of this determination is as follows:

First we try, with a corner of the given mineral, to scratch the members of the scale, beginning from above, in order that we may not waste unnecessarily the specimens representing lower members. After having thus arrived at the first, which is distinctly scratched by the given mineral, we have recourse to the file, and compare upon it the hardness of this degree, that of the next higher degree, and of the given mineral. Care must be taken to employ specimens of each of them nearly agreeing in size and form, and also as much as possible in the quality of their angles. From the

resistance these bodies oppose to the file, and from the noise occasioned by their passing over it, we infer with perfect security, their mutual relations in respect to hardness. The experiment is repeated with all the alterations thought necessary, till we may consider ourselves as having arrived at a fair estimate, which is at last expressed by the number of that degree with which it has been found to agree nearest, the decimals being likewise added, if required.

The files answering best for the purpose are fine and very hard ones. Their absolute hardness is of no consequence; hence, every file will be applicable, whose hardness is in the necessary relation with that of the mineral. For it is not the hardness of the file with which we have to compare that of the mineral, but the hardness of another mineral by the medium of the file. From this observation it appears, that the application of the file widely differs from the methods of determining the hardness of minerals which have hitherto been in use; as scratching glass, striking fire with steel, cutting with a knife, scratching with the nail, &c.

Besides an appropriate form, there is another necessary property of the minerals to be determined, consisting in their state of purity. Neither the degree of hardness, nor that of specific gravity, can be correctly ascertained, if we employ impure substances. For the same reason, it would be wrong to make use of minerals which have undergone a total or even partial decomposition; and in general, every circumstance which might influence the hardness must be duly attended to, if we hope to arrive at a useful and correct result.

Minerals that cleave with more facility in one direction than in any other, often shew a less degree of hardness upon the perfect face of cleavage than in other directions. This is exemplified in Cyanite and Mica. If we are engaged in the determination of a mineral by the help of the characteristic, it will be necessary to take a mean term between the two degrees measured, or rather, to lean towards the higher one.

Supposing all the precautions necessary in determining the degrees of hardness to have been taken, and the circumstances well attended to, which might have exercised some influence; we find that those individuals which belong to one and the same species, admirably agree with each other in respect to this property; and that deviations from an exact coincidence, if they happen to occur, do not take place, *per saltum*, but that they are joined with each other by intermediate members. These members produce a series, in most cases between very narrow limits.

§. 99. Specific Gravity.

By the Specific Gravity of minerals, is understood the relation which subsists among them, under equal volumes, as respects their absolute weights.

The determination of the specific gravity depends upon the comparison between absolute weights and volumes. They cannot be instituted at all, or at least not with sufficient accuracy, except by the aid of appropriate instruments.

In ascertaining the specific gravity of minerals, water has been agreed upon as the fixed standard of comparison. This preference has been given from the remarkable facility with which we can compare its weight with that of all other minerals, under equal volumes, in consequence of the discovery of Archimedes, that when a body is immersed in water, it loses a portion of its weight equal to that of the volume of water it displaces, which volume is precisely equal to its own: accordingly, if a body, after having been weighed in air, be weighed in water, the loss of weight which it sustains will necessarily indicate that which belongs to a volume of water exactly equal to its own. Therefore, if we represent the specific gravity of water by any number whatever, we shall obtain the specific gravity of the body weighed, by means of the following proportion: the weight lost by the body weighed, (or, what is the same thing, the weight of a volume of water equal to it,) is to the absolute weight of the body, as the number chosen to represent the specific gravity of water, is to the specific gravity of the body weighed. The number which has been selected to represent the specific gravity of water is 1.

The specific gravity of water being liable to vary, from foreign substances it often contains, and from an alteration of temperature, it is obvious it cannot with propriety be made a standard of comparison, except when perfectly pure, and at a given temperature. For these reasons, distilled water only is employed in ascertaining the specific gravity of minerals, and at a temperature varying as little as possible from 60° F.

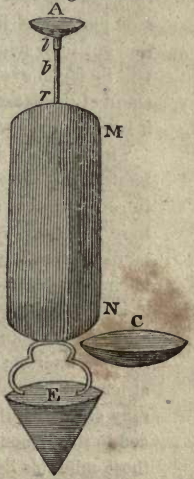
Several instruments are employed in taking the specific gravities of minerals, some of which have reference to the state of the mineral, whether solid, fluid or gaseous. As it will very rarely be necessary to resort to the use of the present character in the determination of liquids and expansible fluids, the arrangements adopted in ascertaining it, in these bodies, will not be described in this

treatise. They can easily be learned by recurring to most of the works on Natural Philosophy, where they are more appropriately described, with every necessary detail. The instruments for determining the specific gravity of solid minerals, are the *Hydrostatic Balance* and *Nicholson's Aræometer*.

The *Hydrostatic Balance* consists of a pair of scales, sufficiently delicate to be turned with the 100th of a grain, when loaded with 300 or 400 grs. The scales should be set upon a stand, and provided with an accurate set of weights, from 100 grs. down to the 20th of a grain. A hook is affixed, under one of the pans, to which is attached the thread or filament, intended to give support to the fragment whose specific gravity is to be ascertained. The vessel which holds the water should be a glass jar, seven or eight inches deep; and a thermometer should be provided for adjusting the temperature of the water. Its delicacy after all will depend upon the thinness of the thread by which the mineral is suspended in the water. A human hair is sufficiently strong for supporting a weight of three hundred grains, and is therefore, in most cases, admirably adapted to the purpose.

Nicholson's Aræometer, Fig. 151, is a hollow cylinder MN, made of white iron; the stem *lr* is a wire of brass, which supports the little cup A and the larger pan C. This stem is marked, towards its middle, by a slight impression *b*, made with a file. From the lower part, is suspended the leaden bucket E. The weight of the instrument is such, that when we plunge it into water, it swims in a vertical posture, with the mark *b* somewhat elevated above the surface of the water. In employing this instrument, the same attention is requisite, as respects the purity and temperature of the water, as in the use of the Hydrostatic Balance. Having introduced the instrument into a tall glass jar of this water, we load the pan C (placed on A) with weights, until the Aræometer sinks so as to make the mark *b* on the stem exactly coincide with the surface of the water. The amount of weight required for this is marked upon the cup, for future use, and is called the *balance weight* of the in-

Fig. 151.



strument. This weight will show the capacity of the instrument; no body of greater weight being capable of having its specific gravity ascertained by it. Let us suppose the capacity of the Aræometer to be known; we proceed as follows to learn the specific gravity of a mineral. A fragment of it is placed in the upper pan C, and weights are added, until the mark *b* coincides with the surface of the water. The amount of weight thus added, is subtracted from the *balance weight;* the remainder is the weight of the mineral in air. The mineral is now transferred to the bucket E. But as all bodies weigh less in water than air, it will be requisite to add more weight to the pan C, in order to bring the mark *b* to its appropriate level. The amount added, in this last case, will be exactly the weight of a quantity of water equal in bulk to the mineral. We are thus brought acquainted with the absolute weights of equal bulks of water and of the mineral, and the ratio of these weights is the ratio of their specific gravities.

The Hydrostatic Balance is the most accurate, and is therefore to be chosen for nice inquiries, such as determining the gravity of very minute specimens, and where it is the object to fix the limits of the range in the specific gravities of a new species. But for the common purpose of finding the specific gravity of minerals, in order to find out their names by the aid of the characteristic, the Aræometer will be found every way sufficient, and generally preferable, on account of the greater expedition with which it can be used. Besides, it is much cheaper and more portable.

The minerals of which we are taking the specific gravity should be perfectly pure. The greatest care must therefore be exercised, in removing, as much as possible, whatever foreign substances adhere to them. And further, we must avoid employing such specimens as contain vacuities. In order to get rid of these, the minerals must be broken down into fragments, until we can select such as appear perfectly continuous, even when viewed by the microscope. Compound varieties are more liable to contain cavities than simple minerals; for this reason, the composition must be overcome, at least so far that it cannot have any more influence upon the accuracy of our results. Yet the minerals must not be too much reduced in size, since this might lead into an opposite error, in supposing those minerals lighter than water, which swim upon it, when reduced to an impalpable powder.

§. 100. Magnetism.

Some minerals act upon the magnetic needle, if they are brought within the sphere of its attraction. Others become magnets themselves. These phenomena are made use of as characters, under the name of *Magnetism*.

The only minerals hitherto known, which exercise a considerable action upon the magnetic needle, are the Native Iron and Octahedral Iron-ore. A few other ores of iron also act upon it, but with much less energy.

Instead of a needle, the horse-shoe magnet may be employed in examining minerals for this property, but in such cases the mineral should be reduced to the condition of a powder.

§. 101. Electricity.

Several minerals produce electric phenomena; some of them by friction, others by pressure, others by communication, and others by heat. Some are electrics; others are conductors of electricity.

Vitreous or positive electricity is produced by friction, in a large number of earthy minerals, as Quartz, Topaz, Emerald, &c. and even in some salts. In the same way, the combustibles, as Sulphur, Amber and Coal, present the phenomena of negative or resinous electricity. As conductors of electricity, the native metals may be mentioned.

Heat produces electric phenomena, in Topaz, Mesotype, Prehnite, Tourmaline, &c. The opposite extremities of the crystals assume opposite kinds of electricity, and therefore possess electric axes.* Boracite exhibits four electric axes, coinciding with the axes of the Cube, which is the form of its crystal. This difference

* In cut and polished pieces of transparent Tourmaline, electrical excitement is produced by natural fluctuations of temperature in the air; or, in other words, this substance may be said to be spontaneously electric.

in the electric phenomena is very often accompanied by a different configuration of the opposite terminations of crystals. (§. 50, p. 47.)

The phenomena relating to the electricity of minerals have not, hitherto, been found very useful in mineralogy: they have rather excited attention, as physical curiosities, than as important characters. For this reason, the apparatus required for observing these phenomena will not be described in the present treatise. It may be found, however, in most works relating to the subject, which the student can consult in case he wishes to enter upon these investigations.

§. 102. Taste.

Several minerals produce a sensible taste.

All the acids and many of the salts produce some taste. The soluble salts not occuring, in general, with any of the characters required for their exact determination, their taste is almost the only one left to which we are able to recur; accordingly, it has been found useful to provide the differences in the kinds of taste with particular denominations. The following expressions have been adopted:

1. *Astringent* for the taste of Vitriol.
2. *Sweetish* for the taste of Alum.
3. *Saline* for the taste of Common Salt.
4. *Alkaline* for the taste of Carbonate of Soda.
5. *Cooling* for the taste of Salt-petre.
6. *Bitter* for the taste of Epsom salt.
7. *Urinous* for the taste of Sal-ammoniac.
8. *Sour* for the taste of Sulphuric acid.

Besides, the intensity or other peculiarities of several kinds of taste may be indicated, which will be done in the progress of the work in a manner sufficiently plain to be understood, without farther explanation in this place.

§. 103. Odor.

There are minerals which, either spontaneously or when rubbed, emit some odor.

Several varieties of Bitumen possess a bituminous odor. Iron Pyrites emits a sulphureous smell when two pieces are forcibly struck together so as to strike fire. Arsenical Iron under the same circumstances gives the odor of garlick. Black Limestone of a certain kind emits under the blow of the hammer a fetid smell: pieces of Quartz likewise produce a peculiar odor when struck together.

Sulphuretted Hydrogen, Sulphurous Acid, and other natural gases have various odors; as that of rotten eggs, of burning sulphur, &c.

Besides the characters treated of in the foregoing pages, there are still some phenomena which have been made use of in the description and discrimination of minerals. Among these, the *Adhesion to the Tongue* is almost exclusively met with in decomposed minerals; the *Unctuous and Meagre Touch* are used for distinguishing certain friable minerals; and the *Phosphorescence* produced by heat is also employed in those minerals in which the natural properties are not observable.*

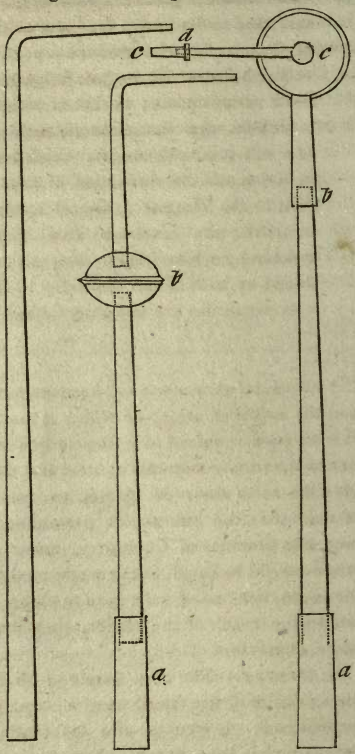
---

* *Chemical characters.*—These are made up of the use of the Blowpipe and the action of acids; of which it may be remarked, that in strictness, it is no more required of a treatise like the present, to describe the manner of examining minerals by heat and the reactions of acids, than it is to give the rules observed by the analyst in ascertaining the composition of minerals: the information pertaining to these subjects being the appropriate province of Chemistry, and should, of course, be looked for, when sought in detail, in the works on that science. It is only to abridge the inconvenience of reference to other books, and which may not be within the reach of the reader, that the following account is given of these characters.

Blowpipe.—The most simple of all blowpipes is that employed by the smiths to direct the flame of a lamp upon small pieces of metal placed on charcoal. It consists of a tapering metallic tube, Fig. 152, ten or twelve inches long, and bent at right angles towards the smaller extremity, where its opening is so small as scarcely to admit a common sized pin; while at the larger end it varies from one sixth to one fourth of an inch. In the operations of the artist, (which commonly consist in little solders,) the small extremity, or beak, is brought near the flame of the lamp, and with the mouth, a current of air is impelled through the tube upon the flame. As the blowing is only required for a moment at a time, no inconvenience arises from the moisture, which is apt to be driven along with the current of air from the lungs. But in the exper-

iments of the chemist, where the blowing must often be sustained for several minutes at a time, a considerable embarrassment is experienced from this source. In endeavoring to avoid this, as well as with a view to render the instrument more portable, several variations have been adopted in its construction. One of these improvements is represented in Fig. 153; at *b*, towards the center of the blowpipe, the tube enlarges into a ball, three fourths of an inch in diameter, in which the moisture from the mouth accumulates, and is removed, occasionally, by being unscrewed at its centre and carefully wiped out. This instrument is made of brass, and furnished with a mouth piece *a*, of ivory. Another form, Fig. 154, and the one to which the preference is given, was introduced by Voigt. It has the chamber or barrel *c*, for the reception of moisture, situated at the angle of the instrument near the beak: it is circular in its form, one inch in diameter, and one eighth of an inch across. The beak issues from the centre of this chamber, and is capable of being turned completely round. Upon its extremity is fitted a little appendage *d*, pierced with a hole more or less fine, through which the air escapes. Three or four of these little cones accompany the instrument of different calibres, which can be substituted for one another at pleasure. Berzelius recommends that they be made of platina, as in using them for a little time, they become coated with lampblack, and if made of this metal are at once cleansed by heating them to redness upon charcoal before the blowpipe. This blowpipe

Fig. 152. Fig. 153. Fig. 154.



is provided with a joint at *b*, and the side of the barrel or cylinder opposite to that from which the beak issues, comes off by unscrewing, for the purpose of enabling us to wipe it dry occasionally. This barrel serves to contain the little appendages of the beak, when the instrument is not in use. This instrument is also made of brass with an ivory mouth piece.

The flame employed in using the blowpipe may be either that of a candle or lamp; though considerable choice exists among candles and lamps for this purpose. A tallow or wax candle in order to answer best, should be made with its wick somewhat larger than ordinary; and of lamps, one furnished with a single wick and fed by olive oil has received the preference. In using the candle, the wick is previously bent in the direction to which we wish to direct the flame.

The keeping up a continual stream of air through the blowpipe is at first attended with some difficulty. This, however, is best overcome by an attention to the following directions. Closing the mouth, keep the cheeks distended with air during a number of inspirations and expirations, performed through the nostrils. Next, attempt the same with the mouth piece of the blowpipe between the lips: now, as this provides an exit for the air in the mouth, unless a fresh supply be kept up from the lungs, the cheeks will soon collapse; in order to prevent this, at the moment of expiration through the nose, a sufficient quantity of air must be allowed to enter the mouth to preserve their distention. By this means, the air in the mouth is constantly subject to the same compression, and flows in an uniform mannner from the little orifice. Having acquired the habit of keeping up a continued current of air from the blowpipe, the beak is now brought within the border of the flame of the lamp or candle. We immediately perceive before the orifice a long and conical blue flame, environed by an outer cone more resembling the ordinary flame of a candle or lamp. It is at the apex of the blue cone that the most intense heat is produced. Much practice, however, is required in order to obtain the maximum heat of this instrument. If the current of air is too strong, the heat is dissipated as soon as produced; if too feeble, there is a deficiency of air for the effect.

Oxidation takes place when we bring the matter of assay before the apex of the exterior flame, where the combustible matter coming from the lamp or candle has ceased to attract oxygen. The heat required in the matter of assay is only that of incipient redness; and one of the larger orifices of the beak is found best for producing this temperature. Reduction, on the other hand, requires a more elevated temperature,

which is best obtained by the aid of one of the finest appendages, the opening of which should be introduced only within the edge of the flame. A less distinctly blue cone than in the former instance, surrounded by a more brilliant one, will be the result. The matter to be deoxidized is to be supported completely within the bright flame, just beyond the apex of the blue cone: this medium consists of an inflammable gas not yet saturated with oxygen, and which, of course, will seek it from the matter of assay.

The ordinary support for the substance placed before the blowpipe is well burnt charcoal. In its selection, it is important to attend to the circumstance of its being freshly burned, and that it be of a light texture; as the more compact charcoal, besides being too good a conductor, is inconvenient on account of the large quantity of ashes it produces. Gahn preferred charcoal from pine wood. Platina wires three or four inches in length, are employed in those cases where the reducing effect of a charcoal support is liable to prevent the reaction which we wish to produce. The matter of assay is easily attached to the wire, by bending up one extremity into a hook, moistening it with the tongue, and dipping it into the powdered flux we have occasion to employ, which adheres to it in sufficient quantity: it is now brought before the flame of the blowpipe where it melts into a drop, and this being brought near the matter of assay, they immediately unite and are melted together. In those instances where it is requisite to roast the matter of assay in order to discover the substances with which it is engaged, little tubes of glass two or three inches in length and about one tenth of an inch in diameter, are employed. The substance to be examined is introduced into the tube and placed at a little distance from one of its extremities, inclining the tube so that this extremity shall be the lowest: the flame of a spirit of wine lamp is now gradually brought to bear upon the tube by means of the blowpipe, and in such a manner that the flame shall play around the part containing the matter of assay: the volatile matters sublime into the upper part of the tube, where they are in part condensed and capable of being recognized. Occasionally in these trials, it is convenient to have a tube closed at one extremity: this is easily prepared from open tubes by the aid of the blowpipe.

The reagents most commonly used with the blowpipe, are the subcarbonate of soda, the borate of soda, and the double salt formed of the phosphate of soda and phosphate of ammonia, which, for the sake of brevity, are called *soda*, *borax*, and *salt of phosphorus*. The objects in view, when the first of these is employed, are to ascertain if the bodies combined with it are fusible or infusible, and to favor the reduction of

the metallic oxides. With the second, we examine whether the fusion of bodies along with it takes place slowly or with rapidity, without apparent movement or with effervescence, whether the glass resulting from the fusion acquires color, and whether this color is different in the fire of oxidation from what it is in the fire of reduction; and finally, we notice whether the discoloration of the borax augments or diminishes by becoming cold, and whether the glass preserves or loses its transparency. The salt of phosphorus is employed particularly in the examination of the metallic oxides, whose characteristic colors it immediately develops: it is also a valuable reagent for the silicates. Charcoal is the support most frequently made use of, when these reagents are employed. In no instance should the quantity employed, of the flux and the mineral together, exceed in size a pepper-corn; and in those instances where a mineral is used without a flux, it should not exceed, in general, the head of a common sized pin.

For more complete information upon the use of the blowpipe, the reader is referred to the excellent treatise of Prof. Berzelius, the first edition of whose work has been translated from the Swedish into both the French and German languages, and the second edition of which was published at Nürnberg, in 1828.

Action of Acids.—The acids employed most generally are the Nitric, the Muriatic and the Sulphuric. When the two former are used to discover the carbonates of the alkalies, of the earths and the metallic oxides, they are employed in a state of dilution; and the mineral to be examined has a small fragment, the size of a pepper-corn, detached, which, either unbroken or crushed to powder, is put into a wine glass, upon which the acid is affused, when the effervescence from the liberation of the carbonic acid gas becomes apparent. If the trial be to learn whether the acid forms a jelly with the dissolved mineral, (and which never takes place with the carbonates, or those that effervesce,) a stronger acid is employed and a larger quantity of the mineral previously reduced to an impalpable powder; a little heat is also requisite, and considerable time is needed for the digestion of the powder: on cooling, the fluid gelatinizes. Occasionally, the color of the solution of a mineral in these acids is noticed, with a view to detect their metallic ingredients. The sulphuric acid is used without dilution, for the purpose of detecting fluoric acid: it is poured upon the mineral in a state of powder, in a glass tube, when the fluoric acid becomes obvious, from the corrosion of the glass.

PART II.

CLASSIFICATION.

§. 104. Identity.

Minerals, (or Individuals,) not differing from each other in any of their natural properties, are identical.

This may be considered as an axiom, not only in mineralogy, but in Natural History generally, and lies at the foundation of the whole theory of the systems in these sciences.

It requires, however, some limitation, or explanation.

By *natural properties*, must not be understood every property with which these productions are endowed, since there are several, which, as they are of no utility for the purposes of mineralogy, are not included in the above expression. Such are, besides the size of crystals, also the disproportionate enlargement of some of their faces, their junction with other individuals, their being implanted, imbedded, &c. These are called the accidental properties of minerals; and individuals which differ only in these respects, are taken for identical ones, equally with those which do not, or which are similar in respect to such circumstances.

Farther, individuals are allowed a certain deviation from perfect similarity in their natural properties, and are still said to be identical.

The forms, for example, among several individuals, are not required to be the same; provided they are members of one and the same series of crystallization, (their remaining properties not being dissimilar,) they are identical. Thus, in the species Fluor, individuals possessed of the form of the Cube, the regular Octahedron, and of the Dodecahedron, are of frequent occurrence, but whose other properties, (as color, hardness, specific gravity, &c.) are similar. Such individuals are identical, because the Cube, the Octahedron, and the Dodecahedron, are members of the same series of crystallization. If we suppose an individual to occur, agreeing with those just mentioned, excepting in form, which we will imagine to be that of the Rhomboid; such an individual cannot be said to be identical with the others, since the difference between it and them

cannot be removed or made to disappear by the idea of a series, and accordingly the individual cannot be brought under the idea of identity.

The same series, as respects lustre and color, have been seen to exist, (§. 89, 93.): with regard to specific gravity and hardness also, a similar gradation is admitted, since the determination of these properties in individuals of the same species does not admit of rigorous limits.* In these cases, it is to be recollected that the series arises out of an uninterrupted connexion among a number of individuals, capable of being so arranged that any two will pass insensibly into each other, and that the chain no where presents any interruption or want of continuity. In the comparison of individuals, this series may take place in but one of the above mentioned properties, while in the remaining ones there exists the most perfect identity, or it may take place in two or three, or all of them, at the same time. To illustrate the idea of identity by series in the character of hardness, for example, we will suppose the comparison of four individuals of the species Beryl. Let them all agree, as respects form, color, lustre and specific gravity; but in hardness we find them to be represented by 7.5, 7.6, 7.7 and 7.8. They are identical, for though differing in hardness, yet the differences are members of a continuous series. If, however, an individual of the species Apatite be compared with these individuals, the form, color and lustre is exactly similar in both cases, but the hardness of the crystal of Apatite we shall find to be 5,—a discovery which immediately destroys the idea of identity, since it is obvious that the difference between 5 and 7.5 is far greater than that between 7.5 and 7.8, which are the extremes of the series in the hardness of the individuals of Beryl. They cannot therefore be said to be identical, since the numbers expressive of their hardness do not form a continuous series.

By the above process, extended to all those properties which form series by these gradations, we may include the assemblage of all those individuals, which, notwithstanding their differences, may yet be brought under the idea of identity. At the same time, those individuals which do not allow the process to be applied to them, are

---

* The series, as respects the properties of hardness and specific gravity, no doubt arises, in a majority of instances, from the intermixture of foreign minerals among the individuals of a species, in addition to the imperfection of our instruments for obtaining accurate results.

excluded with perfect distinctness and accuracy. An assemblage of individuals, formed in this way, does not contain any thing foreign, nor does it want any thing capable of being united with it on account of its natural properties.

§. 105. Difference.

Individuals which do not agree in all their properties are not identical.

If two individuals agree in every one of their properties, except in their crystalline forms, or in color, or in hardness, or in specific gravity, so as to differ only in one of these properties, nevertheless they will not be identical. For the above properties are natural properties, and upon them depends the identity or difference of individuals.

The present proposition, being the reverse of §. 104, like that, requires some limitation.

Accidental differences have no more effect upon the difference of individuals than upon their identity.

Difference between individuals is produced not by a difference in the crystalline form, unless the forms belong to different series of crystallization; nor in either or all of the remaining properties, if individuals are known to exist capable of filling up the difference by regular gradations.

§. 106. Species.

An assemblage of individuals, which fall under the idea of identity, is termed a *species*, and the individuals belonging to it are homogeneous individuals.

This may be said to furnish an invariable idea of the species in mineralogy; one which remains constant in all sciences which concern the productions of the mineral kingdom. It is the foundation of every system, whatever may be the principles followed in its construction. Its correct determination is an object of the highest consequence, since it is the fixed point from which every inquiry has to start, whose object it is to procure some knowledge of the mineral kingdom, of whatever kind this knowledge may be.

§. 107. Transitions.

The progress of the gradations, in the properties of homogeneous individuals, is termed a *transition* or *passage;* and we say of individuals in which such a progress occurs, that *they pass into each other.*

These transitions arise from the series of characters before considered; and individuals connected by transitions are homogeneous, or belong to one and the same species; there can be no transitions, in such cases, from one species to another, although examples of this sort are sometimes found in mineralogical books. In such instances, it is obvious, if the transition exists, the idea of the species is wrong; for under such circumstances, they should coalesce and form but a single species.

From the continuity of the transitions, or of the series of characters from which they depend, we may infer that there is a remarkable connexion within the species, by which all the differences occurring in its individuals may be joined into a whole. In this way, we are assisted in comprehending the variety of the mineral kingdom. For this reason, it is contrary to the interest of mineralogy, to divide or subdivide the species, and to distinguish subspecies and varieties. The purpose of such divisions is to facilitate the general survey of the species; but this indeed would rather be promoted by establishing the connexion between its individuals, if this should happen to be still wanting, than by subdivisions, which render it less evident.

In those treatises where this course has been adopted, the student is often greatly inconvenienced, after he has settled the question that an individual belongs to a certain species, to know under which variety it comes; for it is obvious, that where all the varieties of a species are bound together, as they must be, by intermediary individuals, specimens will occur, which can no more be referred to one variety than to another. Indeed, the effect of such subdivisions is to produce an erroneous idea of the species, as a whole, by causing the pupil to lose sight of those series in the characters of which it allows, and to fix only upon particular members of them, while the remaining ones are wholly overlooked. Accordingly, he is in a condition to recognize those individuals only which are identical with such members of the series as form the varieties in question,

while the determination of the intermediary members, being unprovided for, except in the general description, are a perpetual source of doubt and confusion. These subdivisions are, moreover, entirely arbitrary,—many of them coming from artists and persons whose employment consists in the working of stones; and are unworthy of the attention of the mineralogist. They will not be found to be retained, therefore, in the present work, any farther than the notice of certain varieties which are applied to economical purposes. These will be pointed out with sufficient accuracy, in the second part of the work, merely for the sake of convenience to the economist.

§. 108. Two Kinds of Classification.

There are two kinds of classification in mineralogy, the natural and the artificial, or the synthetical and the analytical. The artificial or analytical classification has for its object, simply, the distinction and the naming of unknown minerals; the synthetical or natural system, is directed to the knowledge of relations among the species with a view to connect them into a system, so that those which resemble each other the most in nature, shall be situated the nearest each other in the arrangement.*

---

* For the gratification of the more advanced student, the following outline of the natural method is given, with the hope, that such may be led by it to consult the profound and philosophical writings of Mohs, from whence it is drawn, and where they will find this system fully developed.

The species themselves are the proper objects of classification, or the things to be classified. It is necessary therefore, to regard them as *wholes*. In taking this view of any one species, all the connexions of certain properties occuring in individuals must be allowed to disappear, and we must view it, not as a compound of single varieties, but as complete as possible.

The principle of classification is the resemblance among natural properties. Several bodies are similar, or resemble each other, which approximate more or less in their properties; and this resemblance is the greater, the higher we find the degree of approximation.

Besides the natural and the artificial systems, there exists a variety of classifications which cannot be included under these heads; such as the arrangement of the species in an alphabetical order, which, being founded upon the name, possesses no real relation with

---

The degrees of resemblance among the properties in different species are not every where the same. We consider the species as varieties to be classified, and compare them with each other in respect to their properties. We perceive that some of them are more, some of them less allied to each other in resemblance. Common Iron Pyrites, for example, is more similar to white Iron Pyrites than to Carbonate of Lime; the latter species again is more similar to Arragonite than to Feldspar.

An assemblage of species united by the highest degree of resemblance in its properties is termed a GENUS. The species of Iron Pyrites agrees so closely with that of white Iron Pyrites, in every character except that of forms, that but for this difference, the two species would coalesce. Here is an example of that degree of resemblance which forms a genus. The same degree of resemblance exists between Euclase and Emerald. In the case of Idocrase, Garnet, and Staurotide, we observe differences in many characters at once, and yet the resemblance is seen to be as great as in the examples of Iron Pyrites and Emerald. These examples prove, that there may exist differences, sometimes only in a few, sometimes in many characters at a time, without having any influence upon the degree of resemblance itself. On this account, it becomes impossible to express this resemblance by the agreement in one or a certain number of characters. This, however, does not prevent the application of the idea of the genus to these natural productions altogether; for this application does not pre-suppose the idea to be limited to single characters; but it allows, and even requires, to preserve it in its full generality.

The genera being thus founded upon the resemblance of the species constitute a series, which it is clearly impossible should be the case with the species themselves. To convince ourselves of this, we have only to attempt a series of species, in which those placed nearest, must (of course,) resemble each other most, and where we may begin at any chosen member. In forming such a series, we very soon meet with species, which render it doubtful whether the one or the other, or even a third or fourth, &c. should follow the preceding species, and at last, we must either entirely abandon the experiment, or we must suppose, that two, three, or more species occupy the same place in the series. The groupes of species thus formed, however, are the genera themselves in a Natural system; in the real existence of which we discover the fact,

the object, and of consequence, is useless except to those who are already acquainted with the names ;* chemical arrangements, where minerals have been studied more with regard to their relations to their chemical than to their natural properties, and which involve

---

that there exist species, between which there is a similar degree of resemblance, and which are more allied to each other than to any other species out of the groupe, a discovery which lies at the foundation of the idea of the genus. A demonstration of these remarks may easily be acquired by any person familiar with the species in mineralogy.

The mineral kingdom is, therefore, represented by a series of genera, exactly as in the animal and vegetable kingdoms, and like them it does not contain a series of single species. Each of these genera contains similar species, (if it contains more than one,) every one of these again being the assemblage of homogeneous individuals. Their succession in the series is made to depend upon their greater or less agreement, or similarity.

The *order* is, in respect to the genera, what the genus is to the species. The idea of it is therefore obvious from the preceding remarks. A few observations will illustrate its mode of application.

The genus Iron Pyrites, in the peculiar place it occupies in the general series of genera, is surrounded by several other genera, which exhibit so high a degree of resemblance to each other, that they seem to have been formed after a common type or original. These are the genera Nickel Pyrites, Cobalt Pyrites, Arsenical Pyrites and Copper Pyrites. There is not another genus to be found in the whole mineral kingdom, as hitherto known, which could be enumerated along with these, without destroying the idea produced by the assemblage of the above mentioned genera. In a similar manner, the genus Iron-Ore is connected, on one side with the genus Manganese-Ore, on the other side with the genera Chrome-Ore, Cerium-Ore, Uranium-Ore, Tantalum-Ore, Copper-Ore, Scheelium-Ore, Tin-Ore, Zinc-Ore and Titanium-Ore. Thus, likewise, around the genus Feld-Spar are assembled the other genera of Spars, under similar circumstances. Every groupe of this kind, which is an assemblage of genera similar to each other, is an order.

The *class* is an assemblage of similar orders; what the genus is to the species, or the order to the genus, the class is in respect to the order. The idea of the class is so comprehensive, that it becomes difficult to judge of its applicability, without the direct inspection of the objects themselves. This inspection proves that every one of the three classes of the natural system in mineralogy does contain orders, which are con-

* Brooke.

the knowledge and practice of chemistry, in order to render them practicable;* mixed methods, where the order of the species is made to depend partly upon the natural properties, and partly upon their chemical constitution,† &c.

---

nected, by a greater degree of similarity, with each other, than with those of other classes.

To give a recapitulation, in a descending order; the mineral kingdom contains three classes. Every class comprehends part of the series of genera, collected into several orders. The classes are not of the same extent; and the orders which they contain are joined by an equal degree of similarity. Every order is an assemblage of several genera in their regular succession; hence it is likewise a portion of the general series of genera. The genera comprised within an order, present equal degrees of similarity. Every genus is an assemblage of similar species; it is an unity in the series of genera. The species within the genera are connected by equal degrees of similarity. Every species is an assemblage of homogeneous individuals; the individuals of a species are connected by the series of characters, that is to say, by real natural transitions. The individual is the simple mineral, produced by nature. It is the only systematic idea which immediately refers to nature, or to which an object of observation corresponds.

It is to be observed, that none of these ideas have been obtained, or deduced from the others, by means of a *division*. For, in order to arrive at them, we have not begun with the highest, but with the lowest one, which is that of the individual, and then the idea of the species has been determined according to the idea of homogeneity, those of the genus, order, &c. according to different degrees of natural, historical resemblance; the whole of them, by aggregation or assemblage. Besides the idea of a species, a division would have pre-supposed also that of the mineral kingdom; and it would have required a principle according to which it might have been effected with consistency. The present treatise will show that these conditions in fact may be fulfilled, yet such a division, it will appear, cannot afford the same classes, orders and genera, which have been obtained by the other process, and the degrees of classification which will be thus obtained, while they subserve a very important purpose, will be altogether inadequate to the purpose of giving a general view of inorganic nature, in agreement with the similarity which exists among its productions, which is the last and highest aim of Natural History.

* Berzelius. † Abbé Haüy.

ANALYTICAL SYSTEM.

PRELIMINARY OBSERVATIONS.

The first object with the student in mineralogy being the names of minerals, it becomes necessary to point out with as much clearness as possible the course he must adopt. The most obvious method, and indeed the one which has hitherto been most in practice among learners, is to derive them from a living Instructor; but this being out of the reach of many persons, who would otherwise be glad to form some acquaintance with the mineral kingdom, and where enjoyed being without any certain mode of verification, is exceedingly unsatisfactory. The second thought is to have recourse to books containing descriptions of every species; but the number has now become so great, that the labor of reading them over in succession, in order to assure ourselves of a single mineral, is too great to be encountered without considerable fatigue and loss of time, and consequently, danger of disgust. An analytical method, therefore, whose sole object is, to lead us in an easy and sure manner to the names of minerals, becomes desirable. Its utility in the vegetable kingdom has been abundantly tested; and the only question to be decided is, what shall become the grounds of our divisions in the mineral kingdom, in order to apply to it the same benefit.

If we except the synthetical method of Prof. Mohs, no system is to be found in which the requisite assistance, above alluded to, is afforded. If, for example, we bestow a moments attention upon the arrangement of the Abbé Haüy, the most celebrated hitherto constructed, and which has been made the basis of several popular treatises upon the science, we shall find it incapable of accomplishing this end. It is true, it contains classes, orders and genera; but surely, neither their author nor any other person, ever supposed it possible, that the learner could derive advantage from them in the way in which a Botanist does from similar ideas in the determination of an unknown plant; viz. by first ascertaining its class, then the order, then the genus, and lastly, by reading over the essential differences among the unities within this last general idea, to arrive at the appropriate species. Now, who avails himself of this method as respects the classification of Haüy? Who analyzes a mineral to determine its class, order and genus, with a view of arriving at its name? No one certainly. It might be asked, who can do it?

for how few are able! Most clearly then, it subserves no utility in the determination of unknown minerals. Its sole merit consists, in providing for the proficient in mineralogy, one way of arranging the different objects of his knowledge in his cabinet, and the ideas which relate to them in his mind. This certainly is an object of much importance, but secondary in point of time to the one now under consideration. Our information must first be acquired, before it can be philosophically arranged.

It is otherwise, however, with respect to the system first mentioned: this provides for the determination of the species in a scientific manner, the learner being enabled to proceed to the names of minerals through the intermediate degrees of the class, order, and genus, without being obliged to read over the entire catalogue of species in each instance, when an unknown mineral is to be determined. But, like the system of Natural Orders in botany, it experiences frequent embarrassments from those combinations which the principles of the synthetical method impose, and which render it necessary, in order to distinguish the genera within an order, and the species within a genus, to descend to the observation of characters, too nice and minute in their application, for the use of the beginner. To the advanced student, however, this system becomes more available, since it will often be in his power to determine the place of a mineral by analogy, without the minute study of its characters,—an advantage which no purely artificial system can possess. Like the same system in botany, it is superior to all other methods after a certain amount of knowledge is acquired, but at first, is liable to confuse and discourage. (*D'abord, quant à la facilité, il est évident que, pour le commençant, une méthode artificielle doit paraître, et est en réalité plus facile.* * * * *il est donc bien certain que lorsqu'on ne connaît encore aucune plante, et qu'on est réduit à chercher par soi-même le nom des premières qui se présentent, on doit employer une méthode artificielle; et sous ce point de vue, la plus facile de toutes est la meilleure. Des Classifications naturelles en général comparées aux artificielles.—De Candolle. Théorie élémentaire de la Botanique, p. 52, et seq.*)

§. 109. Division of the Mineral Kingdom into Classes.

The Mineral Kingdom is divisible into three Classes; 1. Minerals possessed of regular forms; 2. Minerals yield-

ing regular forms only by cleavage; 3. Minerals destitute of regular forms, and not affording them by cleavage. The first may be termed the Crystallized class, the second the Semi-crystallized class, and the third the Uncrystallized class.

Minerals possessed of *regular forms* are crystals, and not imitative shapes, (§. 75,) though these also offer a degree of regularity. *Such as yield regular forms only by cleavage*, consist of those minerals commonly referred to, under the expression of highly crystalline, and which afford forms of cleavage by the use of the ordinary mechanical aids. Those minerals, in which heating and immersion in cold water are necessary to effect cleavage, or in which the forms of cleavage can be deduced in no other way than from an examination of their natural joints in a strong light, are not included within the semi-crystallized class. *Minerals destitute of regular forms and not yielding forms of cleavage by the ordinary processes of cleavage*, consist of such as are denominated *massive* (in part), *compact*, and *amorphous minerals*, besides those which are liquid and gaseous.

The minerals belonging to the *crystallized class*, possess the highest degree of perfection, under which the objects of the mineral kingdom occur. From these, the members of the *semi-crystallized class* differ, in the perfection of their characters, only as respects regularity of form; and may therefore be looked upon as intermediate between them and the third class; which is made up of minerals, occupying a place still lower, when viewed, in the completeness of their properties.

It may require an explanation, why a mineralogical method should, unlike the systems in zoology and botany, make provision for any but perfect or crystallized minerals. In the vegetable kingdom it is well known, that no object is considered as classifiable, unless possessed of the parts of fructification; or, in other words, of the highest degree of perfection, in its characters, under which it is capable of appearing. And although the majority of plants, ordinarily under our observation, is imperfect in these respects, no serious inconvenience arises from the fact, since they are all possessed of an active principle, whose operation will at length advance them to maturity; in addition to which, we have no difficulty in finding other individuals of the same species, already in possession of the requisite perfection to enable us to accomplish their determination. But it is otherwise in the mineral kingdom. Semi-crystallized and uncrystallized min-

erals constitute by far the largest part of those requiring determination, and they are wholly destitute of any tendency towards a higher degree of perfection. As we find them, so they remain, (unless, indeed, they become, as sometimes is the case, more imperfect still, from external agencies;) and, unlike the determination of imperfect plants, by the aid of those which are more perfect, it is seldom possible to determine them from their association with crystallized individuals of the same species. From this we see, that a method which should omit to provide for such minerals as are not fully perfect in their characters, would be extremely imperfect in general practice.

As a consequence of this necessity of providing means for the determination of imperfect minerals, has arisen the frequent division of the species. Thus, portions of the species Fluor are found in all of the classes, according as the individuals are crystallized, cleavable or massive. It is to be remarked, however, that this division within the species, (unknown in the other departments of natural history,) never takes place in the crystallized individuals of the mineral kingdom; among which only should we expect to find the rule of preserving the species unbroken observed, since they alone correspond to the classifiable objects in zoology and botany.

§. 110. Division of the Crystallized Class into Orders.

Crystallized minerals are divisible into orders, depending upon their different systems of crystallization.

Each system of crystallization affords the basis of an order, within the present class. And the division takes place throughout, without impairing, in a single instance, the unities of the species it contains; a circumstance obviously depending upon the fact, that all the crystals of any one species belong to one and the same system of crystallization. No species will therefore be found to occur, in the crystallized class, in more than one order.

§. 111. Division of the Semi-Crystallized Class into Orders.

Semi-crystallized minerals are divisible into orders, upon the same principle with the crystallized minerals. (§. 110.)

It has been already seen, that there exists but one form of cleavage in a species, and that this is the same both in the crystallized and semi-crystallized individuals of that species; and, moreover, that it is identical with, and in reality constitutes the primary form or system of crystallization in the species. Consequently, the system of crystallization affords the foundation of a division among the minerals of the present class, with the same facility as in the first class. And we may expect to find, from the known fact that many of the species in the mineral kingdom embrace both crystallized and semi-crystallized minerals, that the same species will exist in both classes, and when this takes place, the division of both being upon one principle, we shall find them contained in the same order in both. For example, Galena occurs in the order of the Cube in the first class, and again in the order of the Cube in the second; Sulphate of Strontian in the order of the right rhombic Prism in the first, and again in the same order in the second, &c.

§. 112. Division of the Uncrystallized Class into Orders.

Uncrystallized minerals are divisible into orders, depending upon the state of aggregation existing among their particles.

Three divisions are thus created, according as the minerals of this class are *solid*, *liquid* or *gaseous*.

The present arrangement is not liable to any objection, on the ground that the natural relations among the species have been disregarded, much less that chemical affinities are overlooked. It is to be tested only, as it does, or does not, afford the most direct means in leading to the names of unknown minerals. The properties upon which it is founded are of easy observation and possessed of sufficient constancy: their examination does not involve a knowledge of other sciences, or require an inconvenient minuteness of detail. What is more easy, for example, than to settle whether a mineral be crystallized, and if not, whether it yield a regular solid by cleavage? These are the only questions to be solved in the determination of the class. And if due attention has been paid by the pupil to the section on Crystallography, the orders in the two first classes may be ascertained

with nearly the same degree of ease. The system of crystallization, in most cases, is a problem to which the lowest attainments in mineralogy are adequate; or rather, it is one, which, until the pupil is able to master, he is unprepared to take a single step to advantage in the study of the mineral kingdom. The orders in the remaining class need only to be mentioned, to be recognized.

§. 113. Arrangement of the Species within the Orders.

The species are arranged in each order, in a series, depending upon the property of Hardness, except in the two last orders of the third class, where it depends upon the property of Specific Gravity.

Where the series depends upon the property of hardness, the orders commence with the softest species, and terminate with the hardest: in the other case, it begins with the lightest and terminates with the heaviest.

Had it promised an additional convenience, in arriving at the names of minerals, through the use of this system, it would have been easy to have divided the orders into genera, depending upon fixed degrees of hardness and specific gravity. The idea of a series within the genus, however, founded upon these properties, seemed preferable, inasmuch as it possesses every possible facility which would attend the division in question, besides the advantage of rendering the arrangement considerably less complicated, both as respects the nomenclature and practice.

PART III.

NOMENCLATURE.

§. 114. General Object of Nomenclature.

The object of Nomenclature, in general, is to furnish names for the objects of Natural History.

Formerly it was the practice in Natural History to designate objects by their characters, or descriptions. For example, a particular grass (now known by a name of two words only,) was denominated, "Gramen myloicophorum carolinianum, seu gramen altissimum panicula maxima speciosa, e spicis majoribus compressiusculis utrinque pinnatis blattam molendariam quodam modo referentibus, composita, foliis convolutis mucronatis pungentibus donatum." (Plukenet. Almag. 173.) But at present, nomenclature seeks to dispense with these long phrases by the substitution of short and easily remembered names.

Nomenclature is of two kinds, *Systematic* and *Trivial*.

§. 115. Systematic Nomenclature.

The object of systematic nomenclature is not only to provide names for the species, but, also to construct them in such a manner, as to indicate the connexion of the species with one another in the system.

The systematic nomenclature has in view two things: viz. to provide denominations for the species, or to determine the objects of which something is to be said, and to remind us of those which are more or less similar to them, by indicating the places they occupy in the general assemblage of the natural productions of the Kingdom.

As the systematic nomenclature is applicable only to the Natural System in Mineralogy, no farther attention will be given in the present treatise to its developement. The zoologist and botanist who

have been accustomed to this admirable contrivance in their respective departments, are referred to the system of Prof. Mohs, where they will find the fullest satisfaction upon this subject.*

§. 116. Trivial Nomenclature.

The trivial nomenclature has for its object merely the denomination of objects.

It is no part of the trivial nomenclature to indicate the connexion which exists among the objects named. Unlike the denominations in the systematic nomenclature, which are composed of several words made up of the names of the order, genus, and species, to which minerals belong, the names in the trivial nomenclature rest

---

* For the sake of those readers who may not find it convenient to consult the work above alluded to, it may be proper to observe, that the order is the highest idea expressed in the nomenclature of Mohs; and that in the selection of the names of his orders, he has invented but two new words, having employed the terms used in ancient mineralogy. The names receive their signification in agreement with the ideas of the orders; thus *Pyrites* embraces the minerals hitherto called by that name. Mica signifies a mineral which may be cleaved with facility into thin, shining laminæ; the order *Mica*, therefore, contains only such species as present cleavage in an eminent degree. The name of the genus is compound, formed by connecting another word with the name of the order: thus, we have *Lead-Glance*, *Augite-Spar*, *Iron-Pyrites*, *&c.* The generic name also refers to the properties of the genus, and expresses as much as possible, some striking feature of its resemblance to other bodies. Such is the name *Garnet-Blende*. The genus thus designated belongs to the order *Blende;* the individuals which it contains very often look like *Garnet*. The denomination of the species is produced through the nearer restriction of the generic name by an adjective. The adjective by which the species is designated within its genus, is one descriptive of its natural properties; and in general, refers to one of those properties of the species which is most useful in distinguishing it from other species of the same genus: hence, the systems of crystallization, and the relations of cleavage, are the most frequently employed;—examples of which are, *Hexahedral*, *Prismatic*, *Rhombohedral Iron-Pyrites;* *Rhombohedral*, *Octahedral*, *Dodecahedral*, *Prismatic Iron-ore*, *&c.*

solely upon the species, and consequently, are not required to consist of more than one word. The trivial nomenclature in mineralogy will, therefore, have the advantage of the systematic, in the conciseness of its names; which indeed, is the only recommendation it may be said to possess. They are derived, for the most part, from colors, persons, localities, and other accidental circumstances; of which, the following are good examples: Kyanite, Olivine, Prehnite, Wavellite, Andalusite, Arragonite, &c.

§. 117. Nomenclature in an Analytical System.

The nomenclature in an analytical system must be a trivial one.

Since, in an analytical system, we must not look for similarity among the species of any one class or order, to name the species in such a manner as to suggest the class and order to which they individually belong, instead of serving to illustrate or simplify the general survey of the mineral kingdom, would only produce confusion. A designation, therefore, wholly irrespective of any such relations should be employed. All that we demand of nomenclature, so far as the analytical method is concerned, is the simplest designation of the object possible, from which we may be pointed forward to the descriptions for the remaining information of which we are in search; we have no interest in being carried back to the artificial ideas by whose means we have accomplished this preliminary step.

It is true, provided the names employed in the analytical method do not lead us back to the orders and classes of that method, it would not be very objectionable what denominations were employed, whether those of the systematic nomenclature, or the chemical names, so far as minerals are possessed of them; yet, as the object of this method is only a preliminary step, those which are the shortest and most convenient seem preferable, and these are the trivial names.

At the same time, care has been taken to give, in a smaller type, the systematic names of Mohs, and some of the important synonyms of other authors, in order to enable the student to refer with convenience, to the general descriptions in different works upon the science.

PART IV.

CHARACTERISTIC.

§. 118. Definition.

The characteristic is the assemblage of certain natural properties, arranged according to a certain system, for the purpose of distinguishing the unities in that system.

The characteristic pre-supposes the system, to which it is applied, to have been already developed, and therefore is not the source of the system. Without a system, it cannot exist; because the distinction of bodies, by its means, takes place only within the unities of a system.

Any single property, or a collection of several properties, if it be subservient to the distinction of several species of a genus, or of several genera of an order, or of several orders of a class, is termed a *character;* and the single properties it contains, are its characteristic terms or marks. If a character contains only one characteristic mark, this mark itself represents the character.

Characters are *natural* or *artificial*, according as they refer to a natural or artificial system. Their denomination corresponds to their object; thus, we have *characters of the orders, characters of the species, &c.*

§. 119. Properties of the Characters.

The characters must be sufficient for a precise distinction within their respective spheres, and as short as the necessary degree of evidence in the determination of the species will allow.

Characters are useless, if they serve for the distinction only of some of the species contained within their genus, (or order, if this

be the next superior idea of the system.) The shorter the character is, the more facility and certainty will it afford in the distinction; hence characters should be so constructed as not to contain any thing but what is required for the evidence and distinction of the species.

§. 120. Characters of the Classes and Orders.

The characters for the classes and orders in the analytical system are formed by the distribution in producing the system, and consist of single marks.

In this system, minerals are formed into classes from the following considerations; viz. crystallized minerals, semi-crystallized minerals, and uncrystallized minerals. (§. 109.) Now the characters of the classes are,—for the first class, "minerals crystallized;" for the second, "minerals semi-crystallized;" and for the third, "minerals uncrystallized." But these, it is obvious, are the grounds upon which our division of minerals into classes is founded. The character, moreover, for each of the classes, consists of a single characteristic mark. The same is true as respects the orders, the characters of which depend upon the same property as was employed for their formation, and as these divisions are formed upon single properties, so the characters for the orders will consist of single terms.

In the natural classification of the mineral kingdom, single characteristic terms cannot be employed, as nothing short of a compound character is here found sufficient for a general distinction. It is in this respect, in particular, that the analytical method has the advantage in practice.

§. 121. Characters for the Species.

The characters for the species must be so arranged as to effect the determination of individuals in the most sure manner, of which the science is capable.

For this reason, the species in each of the orders, excepting the two last of the uncrystallized class, are arranged in an order depending upon their degrees of hardness; and have this property given as the first term in their characters. But hardness, by itself, is insuffi-

cient for the distinction aimed at; since it so happens that in several of the orders, and especially in the first order of the third class, a number of species frequently coalesce so far as this property is concerned, or form equal members in the series. In order for a distinction in these cases, additional marks require to be added. Accordingly, the specific gravity, sometimes the angle at which particular faces incline, (when the mineral is crystallized or semi-crystallized,) occasionally also the lustre, streak, taste, &c. are added to complete the character. In the second and third orders of the third class, the property according to which the species are arranged is specific gravity; and this, of course, furnishes the first term of the character among these species.

It is obvious, that in distinguishing the species by characters, we need more marks than are really indispensable merely to exclude an individual from those species to which it does not belong; for we wish to be assured that it does belong to the species under which our arrangement of characters finally brings it. For example, in the first order of the first class, the two species Horn Silver and Common Salt are capable of being distinguished from each other, merely by the property of hardness, that of the first being = 1...1·5, and that of the second being = 2. But, another mineral may be found which on account of its properties comes within this order, and which is possessed of the hardness of one or the other of these species. Under these circumstances, provided the characters of Horn Silver and Common Salt are confined to the property of hardness, this mineral, though really distinct, must coalesce with the one with which it agrees in its character; whereas had the specific characters of these species been extended so as to include the property of specific gravity, it might have easily been discovered that it was a distinct species. It is on this account, therefore, that the characters of the species never consist of less than two marks, and sometimes they are possessed of three or even four.

§. 122. Use of the Characteristic.

The use of the characteristic in mineralogy is the same as in zoology and in botany,

If a mineral is to be determined, the first step relates to its form. If regular, the system of crystallization requires to be ascertained. If irregular, but yielding a regular form by cleavage, the same

question is to be determined. If irregular, but not yielding a form of cleavage, it is merely to be observed whether it be solid, liquid or gaseous. In case the mineral be neither liquid nor gaseous, the next question will be, the degree of hardness it possesses.

The examination being conducted thus far, the characteristic may be applied, from which we learn the nature of those observations still necessary to be made, before arriving at the end in view. In illustration of the entire process, let us take the following example. Let the mineral be crystallized under the form of the regular rhombic Dodecahedron, the cleavage being parallel to the faces of the Cube; and let its hardness be $= 2{\cdot}5$. The information respecting the form of our mineral conducts us to Class I. and Order I. while that relating to its hardness effectually excludes it from No. 1, and those species below No. 7. This group of species, not differing from our mineral in respect to this mark by an amount above unity in the scale, are considered as possessing the same degree of hardness. The mineral then belongs to one of these six species. The next characteristic mark to be observed, for the exclusion of those members of the group to which it does not belong, consists of the specific gravity. Let the specific gravity of our mineral be $7{\cdot}4$. This observation separates three of the group, at the same time that it identifies the mineral under examination with one of the remaining two, while the other is not excluded by a difference above $\cdot 5$; an amount of difference always necessary for perfect exclusion in specific gravity. Another mark is therefore required, to complete the characters of these two species. This mark we find to be connected with cleavage. No. 5 is easily cleavable, whereas no remark being appended to No. 4, it is not easily cleavable. Let our mineral be easily cleavable. No. 3 is of course excluded, and the mineral under examination is No. 5, Galena.

Let us suppose another instance. Let the mineral be crystallized; the system of crystallization a right rhombic Prism, and hardness $= 7{\cdot}5$. It belongs, therefore, to Class I, Order X; and is one of the species contained between No. 45 and the end of the order. Let the specific gravity be $= 3{\cdot}5$. This excludes all but Nos. 50, 51, 52 and 53. The final mark is the inclination of the lateral planes. Let this be M on M 129°. This observation proves the mineral to coalesce with Staurotide, while it excludes it perfectly from the remaining three.

These are ordinary examples. It will not frequently, however, be found requisite to proceed so far in the characters of many of the species, excepting the one which comprises the individual; since

exclusive terms will often be met with, in the commencement of the characters of those species to which the individual under examination does not belong.

FARTHER EXPLANATIONS RELATING TO THE CHARACTERISTIC.

1. Wherever, in the different orders of solid minerals, a break in the series of hardness occurs, it is marked by a line of separation; and the species in those cases where more than one exists between every two lines, are arranged in the order of their specific gravities.

2. The minerals contained in the appendices of the orders in the two first classes consist of species concerning whose systems of crystallization our knowledge is yet imperfect; it is believed however, that they are referred to those orders where the student would most naturally be led to look for them, in a majority of cases. The appendix to the first order in the third class, embraces such minerals as are yet too imperfectly described to enable us to decide whether they constitute independent species, or coalesce with others already known.

3. At the conclusion of several orders in the first and second classes, references enclosed by a parenthesis, to members of other orders will be observed, the object of which is to indicate to the inquirer, who has run over ineffectually a particular order, in what other order the object of his search may be found. For example, let the mineral be an uncleavable crystal of the form of the regular Octahedron, whose hardness = 2·5...3·0. and whose Specific gravity = 8·4...8·9. Order III in class I. would first be recurred to: but it would be found impossible to identify it with either of its species. At the end of the order, however, reference is made to Species 6, Order I; by turning to which, we discover an agreement between its character, and the properties of the mineral in question.

4. The names in small capitals, which are preceded by the sign ?, and whose characters are carried out *in parenthesis* are not regarded by the author as fully entitled to stand as distinct species; but are conceived to belong to those species which they immediately succeed in the arrangement.

5. Wherever, among the synonyms, a mark of interrogation follows a name, it is intended to indicate a doubt whether the substances to which it is applied, belong to the species with which such name is arranged.

6. When the mark of interrogation follows the numbers which express the hardness, specific gravity or dimensions of particular forms, it signifies that such numbers are only to be regarded as approximating to the truth, in the respective cases.

7. The sign ¶ placed before the name of a species indicates that localities of it are known in the United States.

8. The sign || signifies that those species before which it is placed, are of comparatively rare occurrence.

9. The number of species whose individuals never occur, except in the crystallized state, being extremely small, it has been deemed expedient to introduce them into the uncrystallized class; since it sometimes happens that it is necessary to determine a crystallized mineral, whose crystalline form we may be incapable of ascertaining from its natural imperfection, or some artificial alteration it has suffered. Such minerals will be preceded by the sign §.

10. In the semi-crystallized class, those species which have already occurred in the crystallized class, will be denoted simply by their trivial names. In connexion with the names of such species, however, will be found, a reference back to the page of the crystallized class where they are first mentioned. The same rule will also be observed in the first order of the uncrystallized class.

CHARACTERS

OF THE

SPECIES.

CLASS I.

I. ORDER.

	Names.	Hardness.
1.	HORN SILVER.	
	Hexahedral Pearl-Kerate. M.	
	Chloride of Silver.	1·0...1·5.
2.	COMMON SALT.	
	Hexahedral Rock-Salt. M.	
	Chloride of Sodium.	2·0.
3. ¶	CUBE-ORE.	
	Hexahedral Lirocone-Malachite. M.	
	Arseniate of Iron.	2·0...2·5.
4.	VITREOUS SILVER.	
	Hexahedral Silver-Glance. M.	
	Sulphuret of Silver.	" "
5. ¶	GALENA.	
	Hexahedral Lead-Glance. M.	
	Sulphuret of Lead.	2·5.
6. ¶	NATIVE COPPER.	
	Octahedral Copper. M.	2·5...3·0.
7. ¶	NATIVE SILVER.	
	Hexahedral Silver. M.	" "
8. ¶	ANALCIME.	
	Hexahedral Kouphone-Spar. M.	5·5.
9. ¶	TROOSTITE.	
	Ferruginous Silicate of Manganese. *Thomson.* Silicate of Zinc. *Vanuxem* and *Keating.*	"
10.	BRIGHT WHITE COBALT.	
	Hexahedral Cobalt-Pyrites. M.	
	Arsenical Cobalt.	"
11.	LEUCITE.	
	Trapezoidal Kouphone-Spar. M.	5·5...6·0.
12. ¶	IRON PYRITES.	
	Hexahedral Iron-Pyrites. M.	
	Bisulphuret of Iron.	6·0...6·5.

CUBE.

Sp. Gravity.	Various Observations.
5·5.	
2·25.	
2·9...3·0.	
7·19.	Cleavage imperfect.
7·4...7·6.	Cleavage eminent.
8·4...8·9.	Color red.
10·0...10·5.	
2·0...2·2.	
3·8...4·1.	
6·1...6·35.	
2·4...2·5.	The trapezohedron is the only occurring form.
4·9...5·05.	

Names.	Hardness.
13. ‖ BORACITE.	
Tetrahedral Boracite. M.	
Borate of Magnesia.	7·0.

II. ORDER.

Names.	Hardness.
1. FAHLERZ.	
Tetrahedral Copper-Glance, M.	3·0...4·0.
2. ‖ HELVIN.	
Tetrahedral Garnet. M.	6·0...6·5.

III. ORDER.

Names.	Hardness.
1. OXIDE OF ARSENIC.	
Octahedral Arsenic-Acid. M.	1·5.
2. ‖ SAL AMMONIAC.	
Octahedral Ammoniac-Salt. M.	
Muriate of Ammonia.	1·5...2·0.
3. ¶ NATIVE GOLD.	
Hexahedral Gold. M.	2·5...3·0.
4. ¶ PURPLE COPPER.	
Octahedral Copper-Pyrites. M.	
Sulphuret of Copper and Iron.	3·0.
5. ¶ RED OXIDE OF COPPER.	
Octahedral Copper-Ore. M.	3·5...4·0.
6. ¶ FLUOR.	
Octahedral Fluor-Haloide. M.	
Fluate of Lime.	4·0.
7. TENNANTITE.	"
8. ¶ ‖ NATIVE IRON.	
Octahedral Iron. M.	4·5.
9. ‖ PYROCHLOR.	
Octahedral Titanium-Ore. M.	4·5...5·5.

Sp. Gravity.	
2·8...3·0.	

TETRAHEDRON.

Sp. Gravity.	
4·4...5·2.	
3·1...3·3.	

REGULAR OCTAHEDRON.

Sp. Gravity.	Various Observations.
3·6...3·7.	
1·5...1·6.	
12·0...20·0.	
4·9...5·1.	
5·6...6·0.	Color red.
3·0...3·3.	
4·2...4·4.	Color lead-grey.
7·4...7·8.	
4·2.	Uncleavable.

	Names.	Hardness.
10. ¶	CHROMATE OF IRON. *Octahedral Chrome-Ore.* M.	5·5.
11. ¶	MAGNETIC IRON-ORE. *Octahedral Iron-Ore.* M.	5.5...6·5.
12. ¶	FRANKLINITE. *Dodecahedral Iron-Ore.* M.	6·0...6·5.
13. ¶ ‖	DYSLUITE.	7·5.
14. ¶	SPINELLE. *Dodecahedral Corundum.* M.	8·0.
15. ¶	AUTOMALITE. *Octahedral Corundum.* M. Gahnite, *Hausmann.*	"
16.	DIAMOND. *Octahedral Diamond.* M.	10·0.

(Native Copper, Sp. 6, Ord. I.)

IV. ORDER.

	Names.	Hardness.
1. ‖	NATIVE AMALGAM. *Dodecahedral Mercury.* M.	1·0...3·0.
2. ¶	BLENDE. *Dodecahedral Garnet-Blende.* M. Sulphuret of Zinc.	3·5...4·0.
3.	SODALITE. *Dodecahedral Kouphone-Spar.* M. Lapis-lazuli. Lazulite. *Haüy.* Haüyne. *Bruun-Neergaard.* Saphirin. *Nose.* Spinellan. *Nöggerath.* Nosin. *Leonhard.* Ittnerite? *Gmelin.*	5·5...6·0.

Sp. Gravity.	Various Observations.
4·4...4·5.	Cleavable.
4·8...5·2.	Magnetic with polarity.
5·0...5·1.	Streak deep red.
4·35...4·6.	Color yellowish brown. Lustre semi-metallic.
3·5...3·8.	Cleavage difficult.
4·1...4·3.	Cleavable.
3·4...3·6.	

RHOMBIC DODECAHEDRON.

Sp.Gravity.	
10·5...12·5.	
4·5...4·8.	
2·28...2·35.	

Names.	Hardness.
4. ¶ GARNET. *Dodecahedral Garnet.* M. Essonite. *Haüy.* Hessonite. *Leonhard.* Rothoffite. Romanzovite. *Nordenskiöld.*	6·5...7·5.
(Native Copper, Sp. 6, Ord. I. Troostite, Sp. 9, Ord. I. Native Gold, Sp. 3, Ord. III. Tennantite, Sp. 7, Ord. III.)	

V. ORDER.

Names.	Hardness.
1. ‖ MELLITE. *Pyramidal Melichrone-Resin.* M. Mellate of Alumine.	2·0...2·5.
2. ¶ MOLYBDATE OF LEAD. *Pyramidal Lead-Baryte.* M.	3·0.
3. ¶ YELLOW COPPER PYRITES. *Pyramidal Copper-Pyrites.* M.	3·5...4·0.
4. ‖ OXAHEVRITE.	4·0...4·5.
5. ¶ TUNGSTEN. *Pyramidal Scheelium-Baryte.* M. Tungstate of Lime.	" "
6. ‖ BLACK MANGANESE. *Pyramidal Manganese-Ore.* M. Hausmannite.	5·0...5·5.
7. ‖ ANATASE. *Pyramidal Titanium-Ore.* M.	5·5...6·0.
8. ¶ TIN-ORE. *Pyramidal Tin-Ore.* M. Oxide of Tin.	6·0...7·0.

Sp. Gravity.
3·5...4·3.

OCTAHEDRON WITH A SQUARE BASE.

Sp. Gravity.	Inclination of P on P″ Fig. 25.	Various Observations.
1·4...1·6.	93° 0′	
6·5...6·9.	130 15	
4·1...4·3.	125 30	
2·21.		Cleaves with difficulty, perpendicularly to the axis.
6·0...6·1.	128 40	
4·7...4·8.	117 30	Cleavage at right angles to the axis.
3·8...3·9.	136 47	
6·3...7·1.	67 50	

Names.	Hardness.
9. ¶ ZIRCON. *Pyramidal Zircon.* M.	7·5.
APPENDIX.	
‖ BRAUNITE. *Brachytipous Manganese-Ore.* Haidinger. (Gismondin, Sp. 9, Ord. IX.)	6·0...6·5.

VI. ORDER.

Name.	Hardness.
1. ‖ LENTICULAR COPPER-ORE. *Prismatic Lirocone-Malachite.* M. Octahedral Arseniate of Copper. *Phillips.* Linsenerz. *Werner.*	2·0...2·5.

VII. ORDER.

Names.	Hardness.
1. SULPHUR. *Prismatic Sulphur.* M.	1·5...2·5.
APPENDIX.	
‖ NAPHTHALINE. Resinous Napthaline. *Koenlein.* (Libethenite, Sp. 30, Ord. X.)	

VIII. ORDER.

Names.	Hardness.
1. ‖ BLACK TELLURIUM. *Prismatic Tellurium-Glance.* M.	1·0...1·5.
2. ‖ HORN QUICKSILVER. *Pyramidal Pearl-Kerate.* M. Chloride of Mercury.	1·0...2·0.

Sp. Gravity.	Inclination of P on P″ Fig. 25.	
4·5...4·7.	84° 20′	
4·8.		

OCTAHEDRON WITH A RECTANGULAR BASE.

Sp. Gravity.	Inclinations. Fig. 26.		
	P on P′.	M on M′.	
2·8...3·0.	60° 40′	72° 22′	

OCTAHEDRON WITH A RHOMBIC BASE.

Sp. Gravity.	Inclination of P on P″ Fig. 27.	Various Observations.
1·9...2·1.	106° 20′	
1·5.		Colors white, green, and yellow; transparent and brittle.

RIGHT SQUARE PRISM.

Sp. Gravity.	Various Observations.
7·0...7·5.	
6·4...6·5.	Color greyish-white.

Names.	Hardness.
3. ‖ URANITE.	
Pyramidal Euchlore-Malachite. Partsch.	
Pyramidal Euchlore-Mica. M.	
Phosphate of Uranium.	2·0...2·5.
4. ¶‖ CORNEOUS LEAD.	
Murio-Carbonate of Lead. *Brooke.*	2·5.
5. APOPHYLLITE.	
Pyramidal Kouphone-Spar. M.	
Albin. *Werner.* Tesselite. *Brewster.*	4·5...5·0.
6. THOMSONITE.	5·0.
7. ¶ SCAPOLITE.	
Pyramidal Feld-Spar. M.	
Meionite. *Werner.* Dipyre. *Haüy.* Bergmanite. *Schumacher.* Wernerite. *Leonhard.* Gabbronite. *Schumacher.* Ekebergite. *Berzelius.* Nuttallite. *Brooke.*	5·0...5·5.
8. ‖ FERGUSONITE.	
Allanite, (in part.) *Phillips.*	5·5...6·0.
9. ¶ IDOCRASE.	
Pyramidal Garnet. M.	
Egeran. *Werner.* Loboite and Cyprin.	6·5.
10. ¶ RUTILE.	
Peritomous Titanium-Ore. M.	
Nigrin. *Werner.*	"
(Tin-Ore, Sp. 8, Ord. V.	
Zircon, 9, "	
Brachytipous Manganese-Ore, Appendix A, Ord. V.	
Bournonite, Sp. 1, Ord. IX.	
Gehlenite, 6, "	
Serpentine, App. A, "	
Epsom Salt, Sp. 8, Ord. X.)	

Sp. Gravity.	Various Observations.
3·0...3·2.	
6·05.	Color pale yellow or pale green.
2·2...2·5.	Cleavage eminent.
2·3.	Long, slender, transparent crystals.
2·6...2·7.	Cleavage imperfect.
5·8.	
3·1...3·4.	
4·2...4·4.	

IX. ORDER.

Names.	Hardness.
1. ‖ BOURNONITE. *Diprismatic Copper-Glance.* M. Antimoine sulfuré plumbo-cupriſères. *Haüy.* Endelione. *Bournon.*	2·5...3·0.
2. ¶ ANHYDRITE. *Prismatic Gypsum-Haloide.* M. *Prismatic Orthoklase-Haloide.* Partsch. Anhydrous Sulphate of Lime. Muriacite. *Werner.* Karstenite. *Hausmann.*	3·0...3·5.
3. ¶ STILBITE. *Prismatoidal Kouphone-Spar.* M.	3·5...4·0.
4. HARMOTOME. *Paratomous Kouphone-Spar.* M.	4·5.
5. ‖ COMPTONITE.	5·0...5·5.
6. ‖ GEHLENITE.	5·5...6·0.
7. ¶‖ COLUMBITE. *Prismatic Tantalum-Ore.* M. Tantalite.	6·0.
8. PERIDOT. *Prismatic Chrysolite.* M. Olivin. *Werner.* Chrysolite. *Werner.* Hyalosiderite. *Walchner.* Tautolite. *Haidinger.*	6·5...7·0.
9. ‖ GISMONDIN. Zeagonite. *Gismondi.* Abrazite. *Brocchi.* Aricite and Phillipsite.	7·5.

RIGHT RECTANGULAR PRISM.

Sp. Gravity.	Various Observations.
5·7...5·8.	
2·7...3·0.	
2·0...2·2.	Cleavage parallel to M (Fig. 29.) eminent.
2·3...2·4.	Color white; transparent. Lesser terminal edges replaced by single planes so as to extinguish the bases, and which incline to each other, under an angle of 177° 5′.
3·02.	Color grey; opake.
6·0...6·3.	
3·3...3·86.	
	The faces of the four sided pyramid, by which it is terminated, incline to each other, under angles of 123° 30′ and 117° 30′.

Names.	Hardness.
10. ¶ CHRYSOBERYL. *Prismatic Corundum.* M. Forsterite.	8·5.
APPENDIX.	
A. ¶ SERPENTINE.	3·0.

X. ORDER.

Names.	Hardness.
1. ‖ KUPFERSCHAUM. *Prismatic Euchlore-Malachite.* Partsch. *Prismatic Euchlore-Mica.* M.	1·0...1·5.
2. ‖ STERNBERGITE.	" "
3. ORPIMENT. *Prismatoidal Sulphur.* M.	1·5...2·0.
4. ‖ GRAPHIC GOLD. *Prismatic Antimony-Glance.* M. Graphic Tellurium.	" "
5. ‖ BOTRYOGENE.	2·0.
6. ‖ KONIGENE.	"
7. ¶ GREY ANTIMONY. *Prismatoidal Antimony-Glance.* M. Sulphuret of Antimony.	"
8. ¶ EPSOM SALT. *Prismatic Epsom-Salt.* M. Sulphate of Magnesia.	2·0...2.5.
9. ‖ WHITE VITRIOL. *Prismatic Vitriol-Salt.* M. Sulphate of Zinc.	" "

Sp. Gravity.	
3·65...3·8.	
2·5.	

RIGHT RHOMBIC PRISM.

Sp. Gravity.	Inclination of M on M′ Fig. 30.	Various Observations.
3·09.		Color apple-green or sky-blue; very sectile.
4·21.	119° 30′	In plates; cleavage parallel to the bases; lustre metallic.
3·4...3·6.	100 0	
5·7...5·8.	107 44	
2·03.	120 0	Color hyacinth-red.
		Color dark emerald-green; crystals barrel-shaped, and closely aggregated.
4·2...4·6.	91 10	
1·7...1·8.	90 30	
2·0...2·1.	90 42	

Names.	Hardness.
10. ‖ THENARDITE.	
Anhydrous Sulphate of Soda.	2·0...2·5.
11. ‖ HAIDINGERITE.	
Diatomous Gypsum-Haloide. Haidinger.	
Prismatic Euclase-Haloide. Partsch.	
Arseniate of Lime.	" "
12. ¶ PYROLUSITE.	
Prismatic Manganese-Ore. Haidinger.	" "
13. ‖ MIARGYSITE.	
Hemi-prismatic Ruby-Blende. M.	" "
14. JAMESONITE.	
Axotomous Antimony-Glance. Partsch.	" "
15. BLACK SILVER.	
Prismatic Melane-Glance. M.	
Sulphuret of Silver and Antimony.	
Brittle Silver-Glance. *Jameson.*	" "
16. ‖ HOPEITE.	
Prismatoidal Orthoklase-Haloide. Partsch.	2·5...3·0.
17. ‖ WHITE ANTIMONY.	
Prismatic Antimony-Baryte. M.	
Oxide of Antimony.	" "
18. ‖ CUPREOUS SULPHATO-CARBONATE OF LEAD.	" "
19. ‖ PERITOMOUS LEAD-BARYTE.	" "
20. PRISMATIC OLIVINITE.	
Prismatic Olive-Malachite. M.	
Right Prismatic Arseniate of Copper. *Phillips.*	3·0.
21. ¶‖ SULPHATE OF LEAD.	
Prismatic Lead-Baryte. M.	"

Sp. Gravity.	Inclination of M on M′ Fig. 30.	Various Observations.
2·73.	125° 0′	
2·7...2·8.	100 0	
4·94.	93 40	
5·23.		Color iron-black; streak dark cherry-red.
5.56.	101 20	
5·9...6·4.	100 0	
2·7.	98 26	
6·2...6·4.	137 0	
6·4.	95	Color deep verdigris-green.
7·07.	102 27	
4·2...4·6.	110 50	Color yellowish green.
6·2...6·4.	103 42	

	Names.	Hardness.
22. ¶	CELESTINE.	
	Prismatoidal Hal-Baryte. M.	
	Sulphate of Strontian.	3·0...3·5.
23. ¶	HEAVY SPAR.	
	Prismatic Hal-Baryte. M.	
	Sulphate of Barytes.	
	Wolnyn. *Jonas.*	" "
24. ‖	ATACAMITE.	
	Prismatoidal Habronemc-Malachite. M.	
	Chloride of Copper.	" "
25.	WITHERITE.	
	Diprismatic Hal-Baryte. M.	
	Carbonate of Barytes.	" "
26. ¶	WHITE LEAD ORE.	
	Diprismatic Lead-Baryte. M.	
	Carbonate of Lead.	" "
27. ‖	STRONTIANITE.	
	Peritomous Hal-Baryte. M.	
	Carbonate of Strontian.	3·5.
28.	WAVELLITE.	
	Prismatic Wavelline-Haloide. Partsch.	
	Lasionite. *Fuchs.*	
	Kakoxene? *Steinmann.*	3·5...4·0.
29. ‖	BROCHANTITE.	" "
30. ¶	ARRAGONITE.	
	Prismatic Lime-Haloide. M.	
	Igloite. *Esmark.*	" "
31. ‖	EUCHROITE.	
	Prismatic Emerald-Malachite. M.	" "
32. ‖	SKORODITE.	
	Prismatic Fluor-Haloide. M.	" "

Sp. Gravity.	Inclination of M on M′ Fig. 30.	Various Observations.
3·6...4·0.	104 0	
4·1...4·7.	101 42	
4·0...4·3.		
4·2...4·4.	118 30	
6·3...6·6.	117 18	
3·6...3·8.	117 32	
2.33.	122 15 117	Color emerald-green.
2·6...3·0.	116 10	
3·0.	117 20	
3·0...3·2.	120 10	Color bluish-green.

Names.	Hardness.
33. ‖ LIBETHENITE.	
Diprismatic Olivine-Malachite. M.	
Phosphate of Copper.	4·0.
34. MANGANITE.	
Prismatoidal Manganese-Ore. Haidinger.	
Grey Oxide of Manganese.	4·0...4·25.
35. ¶ ELECTRIC CALAMINE.	
Prismatic Zinc-Baryte. M.	
Siliceous Oxide of Zinc.	5·0.
36. ¶ MESOTYPE.	
Prismatic Kouphone-Spar. M.	
Natrolite. *Werner.*	
Skolezite. *Fuchs.*	5·0...5·5.
37. ‖ POONAHLITE.	" "?
38. ‖ LAZULITE.	
Prismatic Azure-Spar. M.	" "
? CHILDRENITE. *Brooke.*	(4·5)(5·0)
39. ¶‖ DATHOLITE.	
Prismatic Dystome-Spar. M.	
Siliceous Borate of Lime.	
Humboldite. *Levy.*	5·0...5·5.
40. ¶ BROWN IRON ORE.	
Prismatic Iron-Ore. M.	
Hydrous Oxide of Iron.	
Rubinglimmer. *Hausmann.*	
Pyrrhosiderite. *Ullmann.*	
Sideroschisolite. *Wernekink.*	
Göthite. *Lenz.*	
Lepidokrokite. *Ullmann.*	" "
41. ‖ BROOKITE.	5·5...6·0.
42. ¶‖ YENITE.	
Diprismatic Iron-Ore. M.	" "

40½. ¶ PRISMATIC ARSENICAL PYRITES. *Axotomous Arsenical-Pyrites.* M. | 5·0...5·5. | 7·22. | 122° 26'

Sp. Gravity.	Inclination of M on M′ Fig. 30.	Various Observations.
3·6...3·8.	110° 0′	
4·3.	99 40	Brittle; color dark brownish-black.
3·3...3·6.	102 35	
2·2...2·3.	91 20 92 20	
2·9...3·0.	121 30	Color azure-blue. (Color some shade of yellow; in octahedra with rhombic bases.)
" "	103 40	Color greenish-white.
3·8...4·2.	130 40	
	100 0	Cleavage parallel with shorter diagonal; color orange-red.
3·8...4·1.	112 0	Color black, or greenish-black.

Names.	Hardness.
43. ¶ MISPECKEL.	
Prismatic Arsenical-Pyrites. M.	
Arsenical Iron.	
44. FAHLUNITE.	
Tricklasite. *Hausmann.*	6·0...6·5.
45. ¶ WHITE IRON-PYRITES.	
Prismatic Iron-Pyrites. M.	
Sulphuret of Iron.	" "
46. ‖ OSTRANITE.	6·5.
47. ‖ POLYMIGNITE.	"
48. ¶ PREHNITE.	
Axotomous Triphane-Spar. M.	
Koupholite. *Delamèthèrie.*	6·0...7·0.
49. ‖ HUMITE.	6·5...7·0.
50. ‖ GADOLINITE.	
Hemi-prismatic Melane-Ore. Partsch.	
Prismatic Gadolinite. M.	
Ytterite. *Blumenbach.*	" "
51. ¶ ANDALUSITE.	
Prismatic Andalusite. M.	7·5.
? MACLE or CHIASTOLITE.	(5·0)(5·5)
52. ¶ STAUROTIDE.	
Prismatoidal Garnet. M.	7·0...7·5.
53. ¶ TOPAZ.	
Prismatic Topaz. M.	
Pyrophysalite. *Hisinger.*	
Pycnite. *Werner.*	8·0.
APPENDIX.	
A. ‖ ANTIMONY-PHYLLITE.	1·0.
B. ‖ YELLOW TELLURIUM.	

Sp. Gravity.	Inclination of M on M′ Fig. 30.	Various Observations.
5·7...6·2.	111° 12′	
2·6.	100 28	
4·65...4·9.	106 0	
4·3...4·4.	96 0	Very brittle.
4·8.	116 30	Color black.
2·8...3·0.	100 0	Color greenish-white.
2· 3·?	120	
4·0...4·3.	109 30	Color black.
3·0...3·2.	91 20	
(2·94.)	(91 50)	
3·3...3·9.	129 30	
3·4...4·6.	124 23	
4·0. 10·6.	105 30	Color greyish-white.

Names.	Hardness.
C. ‖ ROSELITE.	
Pharmacolite.	
Picropharmacolite. *Stromeyer.*	
Arseniate of Lime.	3·5.
D. ‖ PEGANITE.	4·5.

XI. ORDER.

Names.	Hardness.
1. ¶ GYPSUM.	
Prismatoidal Euclase-Haloide. Partsch.	
Prismatoidal Gypsum-Haloide. M.	
Sulphate of Lime.	1·5...2·0.
2. ¶ VIVIANITE.	
Dichromatic Euclase-Haloide. Partsch.	
Prismatic Iron-Mica. M.	
Phosphate of Iron.	2·0.
3. ‖ COBALT BLOOM.	
Diatomous Euclase-Haloide. Partsch.	
Prismatic Cobalt-Mica. M.	
Arseniate of Cobalt.	2·5.
4. ‖ CUPREOUS SULPHATE OF LEAD.	2·5...3·0.
5. ¶ HEULANDITE.	
Hemi-Prismatic Kouphone-Spar. M.	
Euzeolite. *Breithaupt.*	
Epistilbite.	3·5...4·0.
6. ‖ BREWSTERITE.	5·0...5·5.
7. ¶ WOLFRAM.	
Prismatic Scheelium-Ore. M.	
Tungstate of Iron.	" "

Sp. Gravity.	Inclination of M on M′ Fig. 30.	Various Observations.
2·64.	132° 48′	Color rose-red; in delicate fibres.
2.49.	127° or 128°	Color green.

RIGHT OBLIQUE ANGLED PRISM.

Sp. Gravity.	Inclination of M on T, Fig. 31.	Various Observations.
2·2...2.4.	113° 8′	
2·6...2·7.	125 15	
2·9...3·1.	124 51	
5·3...5·43.	102 45	Color azure blue.
2·0...2·2.	130 30	Lustre on P pearly.
2·1...2·2.	93 40	
7·1...7·4.	117 22	

	Names.	Hardness.
8. ‖	ALLANITE. *Tetarto-Prismatic Melane-Ore.* Partsch. Orthite. *Berzelius.*	6·0.
9. ¶	EPIDOTE. *Prismatoidal Augite-Spar.* M. Zoisite. *Werner.* Thulite. *Brooke.* Withamite. *Brewster.*	6·0...7·0.
10. ‖	EUCLASE. Prismatic Emerald. M.	7·5.

XII. ORDER.

SECTION I.

	Names.	Hardness.
1.	REALGAR. *Hemi-Prismatic Sulphur.* M. Sulphuret of Arsenic.	1·5...2·0.
2. ¶	COPPERAS. *Hemi-Prismatic Vitriol-Salt.* M. Sulphate of Iron.	2·0.
3. ‖	GAY-LUSSITE.	"
4.	RADIATED ACICULAR OLIVENITE. Oblique Prismatic Arseniate of Copper. *Phillips.*	2·5...3·0.
5. ‖	GLAUBERITE. *Prismatic Brithyne-Salt.* M.	" "
6. ‖	HYDROUS PHOSPHATE OF COPPER.	4·5...5·0.

Sp. Gravity.	Inclination of M on T, Fig. 31.
4·0.	115° 0′
3·2...3·5.	115 40
2·9...3·1.	130 50

OBLIQUE RHOMBIC PRISM.

PRISM OBLIQUE FROM AN ACUTE EDGE.

Sp. Gravity.	Inclination of M on M′ Fig. 32.	Various Observations.
3·5...3·6.	74° 14′	
1·8...1·9.	82 20	
1·9.	70 30	Very brittle, colorless and transparent.
4·19.	56 0	Not very brittle; color dark verdigris-green.
2·7...2·8.	83 20	Semi-transparent.
4·2.	37 30	

Names.	Hardness.
7. ¶ SPHENE. *Prismatic Titanium-Ore.* M. Silico-calcareous Oxide of Titanium.	5·0...5·5.
8. ¶ LAUMONITE. *Diatomous Kouphone-Spar.* M.	1·5...5·5.
9. ¶ PYROXENE. *Paratomous Augite-Spar.* M. Diopside. *Werner.* Allalite. *Bonvoisin.* Fassaite. *Werner.* Pyrgom. *Breithaupt.* Omphazite. *Werner.* Hedenbergite. *Berzelius.* Jeffersonite. *Keating.* Achmite. *Stromeyer.* Protheéite.	5·0...6·0.
APPENDIX.	
A. ‖ BUCKLANDITE.	

SECTION II.

Names.	Hardness.
1. BORAX. *Prismatic Borax-Salt.* M. Borate of Soda.	2·0...2·5.
2. ‖ CHROMATE OF LEAD. *Hemi-Prismatic Lead Baryte.* M.	2·5.
3. ‖ WAGNERITE. *Hemi-Prismatic Fluor-Haloide.* M. Pleuroklase. *Breithaupt.*	3·0...3·5.
4. ¶ GREEN MALACHITE. *Hemi-Prismatic Habroneme-Malachite.* M. Carbonate of Copper.	3·5...5·0.

1½. ¶ MICA. *Rhombohedral Talc-Mica.* M.	2·0...2·5.	2·8...3·0.	100°
3½. ¶ BLUE MALACHITE. *Prismatic Azure-Malachite.* M.	3·5...4·0.	3·7...3·9.	98° 50′

Sp. Gravity.	Inclination of M on M′ Fig. 32.	Various Observations.
3·4...4·4.	76° 2′	
2·3...2·4.	86 15	
3·2...3·5.	87 5	
	70 40	Black; opake.

OBLIQUE FROM AN OBTUSE EDGE.

Sp. Gravity.	Inclination of M on M′ Fig. 32.	Various Observations.
1·7.	133° 30′	
6·0...6·1.	93 30	
3·1.	95 25	P on M 109° 20′; crystals complicated, resembling in color and lustre, the Brazilian Topaz.
3·6...4·5.	107 20	

Names.	Hardness.
5. ‖ BARYTO-CALCITE. *Hemi-Prismatic Hal-Baryte.* M.	4·0.
6. ‖ TURNERITE. Pictite.	4.5...5·0.
7. ¶ ANTHOPHYLLITE. *Prismatic Schiller-Spar.* M.	5·0...5·5.
8. ‖ AMBLYGONITE.	5·5.
9· ¶ HORNBLENDE. *Hemi-Prismatic Augite-Spar.* M. Byssolite. *Saussüre.* Pargasite. *Bonsdorff.*	5·0...6·0.
10. ‖ ARFVEDSONITE. *Peritomous Augite-Spar.* Partsch.	" "?
11. ‖ BABINGTONITE. *Axotomous Augite-Spar.* Partsch.	5·5...6·0.
12. ¶ SILLIMANITE.	7·5...8·0.
13. ¶ FIBROLITE. Bucholzite. *Brandes.*	
APPENDIX.	
A. ‖ PYRALLOLITE.	3·5...4·0.

XIII. ORDER.

Names.	Hardness.
1. ‖ BLUE VITRIOL. *Tetarto-Prismatic Vitriol Salt.* M. Sulphate of Copper.	2·5.
2. ‖ DIASPORE. Blattriger Hydrargillite. *Hausmann.*	5·0...5·5.

Sp. Gravity.	Inclination of M on M′ Fig. 32.	Various Observations.
3·6.	106° 54′	
	96 10	Crystals small, yellowish, semi-transparent.
3·0...3·3.	125 0	
2·9...3·0.	106 10	
2·8...3·2.	124 30	
3·3...3·4.	123 55	
	155 25?	Color black, cleavage only parallel with one terminal, and one lateral, plane.
3·2.	99 30	Cleavage brilliant, parallel with the longer diagonal.
"	100 0	
2·6.	94 36	

DOUBLY OBLIQUE PRISM.

Sp. Gravity.	Inclinations of primary planes, Fig. 36.		
	P on M	P on T	M on T
2·2...2·3.	127° 30′	115° 0′	93° 30′
3·43.	108 30	101 20	65 0

Names.	Hardness.
3. ‖ LATROBITE.	
Diploite. *Breithaupt.*	5·5.
4. ¶ FELDSPAR.	
Prismatic Feld-spar. M.	
Ice-Spar. *Werner.*	6·0.
? ORTHOKLASTIC FELSITE. *Breithaupt.*	(")
? PEGMATIC FELSITE. *Breithaupt.*	(5·75.)
? MIKROLINOUS FELSITE. "	(5·75...6·0.)
? MURCHISONITE. *Levy.*	
? RYAKOLITE. Glassy Feld-spar.	
5. PERIKLIN.	
Heterotomous Feld-spar. Partsch.	6·0.
? HYPOSKLERIC FELSITE. *Breithaupt.*	(5·0...5·5.)
? VALENCIAN FELSITE. *Breithaupt.*	(6·0...6·25.)
6. ¶ ALBITE.	
Tetarto-Prismatic Feld-spar. Partsch.	
Cleavelandite. *Brooke.* Tetartin. *Breithaupt.*	6·0.
7. ¶ LABRADORITE.	
Polychromatic Feld-spar. Partsch.	
Labrador Feld-spar.	"
8. ANORTHITE.	
Anorthotomous Feld-spar. Partsch.	
Christianite and Biotine. *Monticelli & Covelli.*	"
9. ¶ FOWLERITE.	
Ferro-Silicate of Manganese. *Thomson.*	
Manganesian Feldspar. Crystallized Siliceous Oxide of Manganese.	
Silicate of Manganese? *Thomson.*	"

Sp. Gravity.	Inclinations of primary planes, Fig. 36.		
	P on M	P on T	M on T
2·7...2·8.	91° 9′	98° 30′	93° 30′
2·5...2·6.	90 0	120 15	112 45
(2·56...2·57.)	(90 0)	(120 36)	(112 18½)
(2·56.)	(90 0)	(120 33½)	(112 22)
(")	(90 21)	(118 35)	(112 15)
	(90)		(106 50?)*
2.57			
2·54...2·56	93 19		114 45
(2·60...2·61)	(93 32)	(120 5)	(111 20)
(2·52.)	(93 0)	(122 30)	(113 0)
2·6...2·68.	93 30	117 53	115 5
2·69...2·76.	94 30	119	115
2·6...2·7.	94 12	117 28	110 37
3·5...3·8.	95 0	121 0	113 0?

* The two cleavages at right angles have the lustre of common Feldspar, the third cleavage has a nacreous lustre.

Names.	Hardness.
10. ¶ KYANITE. *Prismatic Disthene-Spar.* M.	5·0...7·0.
11. ‖ AXINITE. *Prismatic Axinite.* M.	6·5...7·0.
APPENDIX.	
A. ‖ HERDERITE.	5·0.

XIV. ORDER.

SECTION I.

Names.	Hardness.
1. ‖ COPPER MICA. *Rhombohedral Euchlore-Mica.* M. *Rhombohedral Euchlore-Malachite.* Partsch. Rhomboidal Arseniate of Copper.	2·0.
2. CINNABAR. *Peritomous Ruby-Blende.* M. Sulphuret of Mercury.	2·0...2·5.
3. ‖ SULPHATO-TRI-CARBONATE OF LEAD. *Axotomous Lead-Baryte.* Partsch.	2·5.
4. ¶ VITREOUS COPPER. *Prismatic Copper Glance.*	2·5...3·0.
5. ‖ LEVYNE. *Macrotypous Kouphone-Spar.* Partsch.	4·0.
6. ‖ EUDYALITE. *Rhombohedral Almandine-Spar.* Partsch.	5...5·5.

Sp. Gravity.	Inclinations of primary planes, Fig. 36.		
	P on M	P on T	M on T
3·6...3 7	93° 15′	100° 50′	106 15
2·2...2·4.	126 0	93 40	95 15
2·98.*			

* Resembles Apatite, color yellowish and greenish white: brittle, lustre vitreous; strongly translucent.

RHOMBOID.

ACUTE.

Sp. Gravity.	Inclination of P on P′ Fig. 40.	Various Observations.
2·5...3·2.	69° 30′	
6·7...8·2.	72 0	
6·3...6·5.	72 30	Lustre resinous. Streak white.
5·5...5·8.	71 30	
	79 29	
2·89.	73 40	

Names.	Hardness.
7. ‖ CRICHTONITE.	
Craitonite.	
Fer oxidulé titané. *Haüy*	5...5·5.
8. ¶ SPECULAR IRON.	
Rhombohedral Iron-Ore. M.	
Red Iron-Ore.	
Red Hematite.	5·5...6·5.
9. ‖ MOHSITE.	6·0...6·5.
10. ¶ CORUNDUM.	
Rhombohedral Corundum. M.	9·0.

SECTION II.

Names.	Hardness.
1. NITRATE OF SODA.	2·0.
2. RED SILVER.	
Rhombohedral Ruby-Blende. M.	2·0...2·5.
3. ¶ CALCAREOUS SPAR.	
Rhombohedral Lime-Haloide. M.	
Carbonate of Lime.	3·0.
? PLUMBO-CALCITE. *Turner.*	
? ARCHIGONAL CARBON-SPAR. *Briethaupt.*	(")
? KOUPHONE " "	(2·75.)
? EUGNOSTIC " "	(3·0.)
? POLYMORPHOUS " "	(")
? MEROXENE " "	(")
? HAPLOTYPOUS " "	(3·2.)
? MELINOUS " "	(3·0.)
? DIASTATIC " "	(")

Sp. Gravity.	Inclination of P on P′ Fig. 40.	Various Observations.
4·66.	61° 20′	Streak uncolored.
4·8...5·3.	86 10	Streak red.
	73 43	Opake. Iron-black. Lustre high; metallic. Crystals small, flat, circular tables, with alternate re-entering and salient angles on their edges.
3·9...4·0.	86 4	

OBTUSE.

Sp. Gravity.	Inclination of P on P′ Fig. 40.	Various Observations.
2·09.	106° 33′	
5·4...5·9.	109 56	
2·5...2·8.	105 5	Cleavage eminent.
(2·8.)	(104 53½)	
(2·74...2·75.)	(105)	
(2·67.)	(105 2½)	
(2·71...2·72.)	(105 5)	
(2·7...2·71.)	(105 8)	
(2·68...2·69.)	(105 11)	
(2·72.)	(105 13)	
(2·69.)	(105 17)	
(2·77.)	(105 43)	

Names.	Hardness.
? PRUNNERITE. *Esmark.*	
4. ANKERITE.	
Paratomous Lime-Haloide. M.	3·5.
Paratomous Carbon-Spar. *Breithaupt.*	
5. ‖ CARBONATE OF MANGANESE.	
Macrotypous Parachrose-Baryte. M.	
Rose-red Carbon-Spar. *Breithaupt.*	"
? MANGANESEOUS CARBON-SPAR. *Breithaupt.*	(4·0...4·5.)
6. ¶ MAGNESITE.	
Carbonate of Magnesia.	3·0...4·0.
7. BEUDANTITE.	3·0...4·0.
8. ¶ DOLOMITE.	
Macrotypous Lime-Haloide. M.	
Dimeric Carbon-Spar. *Breithaupt.*	
Rautenspath. *Werner.*	
Chaux carbonatée ferrifère. *Haüy.*	
Chaux carb. ferro-manganesifère. *Haüy.*	
Bitter-Spar. Pearl-Spar.	
Miemite. Konite? *Schumacher.*	4·0.
? EUMETRIC CARBON-SPAR. *Breithaupt.*	(")
? TAUTOKLINOUS " "	(3·75...4·0.)
? KRYPTOSE " "	(3·75.)
? ISOMETRIC " "	(4·0...4·5.)
9. ¶ CHABASIE.	
Rhombohedral Kouphone-Spar. M.	
Gmelinite. *Brewster.* Sarcolite. *Vauquelin.* Hydrolite. *De Drée.*	

Sp. Gravity.	Inclination of P on P′ Fig. 40.	Various Observations.
2·9...3·1.	106° 12′	(Color blue. Formerly called a cuboidal variety of Calcareous Spar.)
3·3...3·6.	106 51	
(3·3...3·5.)	(107 30?)	
2·8...2·9.	107 30	
	92 32	In small, black, closely aggregated crystals. Summits of the rhomboids truncated by tangent planes, parallel to which, cleavage takes place.
3·0...3·2.	106 15	
(2·91.)	(106 11)	
(2·96.)	(106 $10\frac{2}{3}$)	
(2·8...2·81.)	(106 19)	
(2·84...2·86.)	(106 19)	

Names.	Hardness.
Haydenite. *Cleaveland.*	4·0...4·5.
? SARCOLITE. *Thomson.*	(5·0...5·5.?)
10. ¶ RHOMB SPAR.	
Brachytypous Lime-Haloide. M.	
Brachytypous Carbon-Spar. *Breithaupt.*	
Carbonate of Magnesia and Iron.	
Breunerite. *Haidenger.* Walmstedite. *Schweigger.*	4·0...4·5.
? HYSTATIC CARBON-SPAR. *Breithaupt.*	(4·5.)
11. ¶ SPATHIC IRON.	
Brachytypous Parachrose-Baryte. M.	
Siderose Carbon-Spar. *Breithaupt.*	
Carbonate of Iron.	
Sphærosiderite. *Hausmann.*	4·0...4·5.
? KAMINOXENE CARBON-SPAR. *Breithaupt.*	(4·0.)
OLIZONE " "	(")
ALLOTROPOSE " "	(4·0...4·25.)
MESITINE " "	(4·0.)
12. ‖ ALUM-STONE.	
Rhombohedral Alum-Haloide. M.	5·0.
13. ‖ DIOPTASE.	
Rhombohedral Emerald-Malachite. M.	5·0.
14. ¶ CALAMINE.	
Rhombohedral Zinc-Baryte. M.	
Carbonate of Zinc.	5·0...5·25.
15. ‖ ILMENITE.	
Axotomous Iron-Ore. M.	5·0...5·5.

Sp. Gravity.	Inclination of P on P′ Fig. 40.	Various Observations.
2·0...2·1.	94° 46′	(Form is described as resembling the cubo-octahedron.)
3·0...3·11.	107 22	
(3·08.)	(107 28½)	
3·6...3·9.	107	
(3·84.)	(107)	
(3·74.)	(107 3)	
(2·99.)	(107 11¼)	
(3·34...3·37.)	(107 14)	
2·5...2·8.	92 50	
3·2...3·4.	126 17	
4·1...4·4.	170 40	
4·6...4·4.		Color dark iron-black.

Names.	Hardness.
16. ¶ QUARTZ.	
Rhombohedral Quartz. M.	
Amethyst. Iron-Flint.	7·0.
17. ¶ TOURMALINE.	
Rhombohedral Tourmaline.	7·0...7·5.
APPENDIX.	
A. ¶ TALC.	
Prismatic Talc Mica. M.	1·0...1·5.
B. ¶ PLUMBAGO.	
Rhombohedral Graphite-Mica. M.	1·0...2·0.
C. ¶ NATIVE MAGNESIA.	
Hydrate of Magnesia.	1·0...1·75.
D. ‖ ZINKENITE.	3·5.
E. ‖ WILLEMITE.	5·5...6·0.?

XV. ORDER.

Names.	Hardness.
1. ¶ SULPHURET OF MOLYBDENA.	
Rhombohedral Molybdena-Glance. M.	1·0...1·5.
2. ¶ PINITE.	2·0...2·5.
3. ‖ CRONSTEDITE.	
Rhombohedral Melane-Mica. Partsch.	" "
4. ‖ NATIVE TELLURIUM.	
Native Tellurium. M.	
Gediegen Sylvan. *Werner.*	
Tellure natif auro-ferrifère. *Haüy.*	" "
5. ‖ POLYBASITE.	2·5.
6. ‖ HERSHELITE.	3·0...3·5.?
7. ARSENIATE OF LEAD.	3·5...4·0.?
8. PYROMORPHITE.	
Rhombohedral Lead-Baryte. M.	
Brown Phosphate of Lead.	3·5...4·0.

Sp. Gravity.	Inclination of P on P′, Fig. 40.	Various Observations.
2·5...2·7.	94° 15′	
3·0...3·2.	133 20	
2·7...2·8.		Laminæ flexible.
1·8...2·0.		In thin, six-sided tables; color iron-black.
2·35.		In regular six-sided prisms; color white.
5·30.		In regular six-sided prisms.
		In small transparent, or translucent crystals

REGULAR HEXAGONAL PRISM.

Sp. Gravity.	Various Observations.
4·4...4·6.	
2·7.	
3·34.	Color brownish-black; streak dark leek-green.
6·1...6·2.	
6·2.	Color iron-black; lustre splendent.
2·1.	In six-sided prisms, whose terminal edges are
5·0...6·4.?	replaced, the new planes inclining to the base under angles of 132°; bases dull and curved.
6·9...7·3.	

Names.	Hardness.
9. ¶ GREEN LEAD-ORE.	
Brachytypous Lead-Baryte. Partsch.	
Phosphate of Lead.	3·5...4·0.?
10. ¶ MAGNETIC IRON-PYRITES.	
Dodecahedral Iron-Pyrites. M.	3·5...4·5.
11. ¶ APATITE.	
Rhombohedral Fluor-Haloide. M.	
Phosphate of Lime.	5·0.
12. NEPHILINE.	
Rhombohedral Feld-Spar. M.	
Sommite. Pseudo-Nephiline. *Fleureau de Bellevue.*	6·0.
? CAVOLINITE.	("?)
? DAVYNE.	("?)
13. IOLITE.	
Prismatic Quartz. M.	
Peliom. *Werner.* Cordierite. *Haüy.* Dichroite. *Cordier.* Steinheilite. *Pansner.*	7·0...7·5.
14. ¶ BERYL.	
Rhombohedral Emerald. M.	
Emerald.	7·5...8·0.
APPENDIX.	
A. ‖ CAPILLARY PYRITES.	
Sulphuret of Nickel.	
(Talc, App. A. Ord. XIV. Plumbago, App. B. Ord. XIV. Hydrate of Magnesia, App. C. Ord. XIV.)	

Sp. Gravity.	Various Observations.
6·9...7·3. ?	
4·4...4·7.	
3·0...3·3.	
2·5...2·6. (2·1.) (2·25...2·3.)	Opake, white; lustre pearly or silky. Surface of the crystals dull.
2·5...2·6.	Dichroism parallel and perpendicular to the prism.
2·6...2·8.	

REESE LIBRARY OF THE UNIVERSITY OF CALIFORNIA.

CLASS II.

I. ORDER.

Names.		Hardness.
1. COMMON SALT.	C. I. p. 154.	2.0.
2. ¶ GALENA.	C. I. p. 154.	2·5.

II. ORDER.

Names.		Hardness.
1. ¶ RED OXIDE OF COPPER.	C. I. p. 156.	3·5...4·0.
2. ¶ FLUOR.	C. I. p. 156.	4·0.
3. ¶ MAGNETIC IRON-ORE.	C. I. p. 158.	5·5...6·5.
4. ¶ FRANKLINITE.	C. I. p. 158.	6·0...6·5.

III. ORDER.

Names.		Hardness.
1. ¶ BLENDE.	C. I. p. 158.	3·5...4.0.

IV. ORDER.

Names.		Hardness.
1. ¶ MOLYBDATE OF LEAD.	C. I. p. 160.	3·0.
2. ¶ TUNGSTEN.	C. I. p. 160.	4·0...4·5.

V. ORDER.

Names.		Hardness.
1. ‖ BLACK TELLURIUM.	C. I. p. 162.	1·0...1·5.
2. ‖ URANITE.	C. I. p. 164.	2·0...2·5.
3. ¶‖ CORNEOUS LEAD.	C. I. p. 164.	2·5.
4. APOPHYLLITE.	C. I. p. 164.	4·5...5·0.
5. ¶ SCAPOLITE.	C. I. p. 164.	5·0...5.5.
6. ¶ RUTILE.	C. I. p. 164.	6·5.

(Anhydrite. Sp. 2. Ord. VI.
Cryolite, Sp. 1. " ")

CUBE.

Sp. Gravity.
2·25.
7·4...7·6.

REGULAR OCTAHEDRON.

Sp. Gravity.
5·6...6·0.
3·0...3·3.
4·8...5·2.
5·0...5·1.

RHOMBIC DODECAHEDRON.

Sp. Gravity.
4·5...4·8.

OCTAHEDRON WITH A SQUARE BASE.

Sp. Gravity.	Inclination of P on P″, Fig. 25.
6·5...6·9.	130° 15′
6·0...6·1·	128 40

RIGHT SQUARE PRISM.

Sp. Gravity.
7·0...7·5.
3·0...3·2.
6·05.
2·2...2·5.
2·6...2·7.
4·2...4·4.

VI. ORDER.

Names.		Hardness.
1. ‖ CRYOLITE. *Prismatic Cryone-Haloide.* M. *Axotomous Orthoklase-Haloide.* Partsch.		2·5...3·0.
2. ¶ ANHYDRITE.	C. I. p. 166.	3·0...3·5.
3. ¶ STILBITE.	C. I. p. 166.	3·5...4·0.
4. ¶‖ COLUMBITE.	C. I. p. 166.	6·0.

VII. ORDER.

Names.		Hardness.
1. ORPIMENT.	C. I. p. 168.	1·5...2·0.
2. ¶ GREY ANTIMONY.	C. I. p. 168.	2·0.
3. ‖ WHITE ANTIMONY.	C. I. p. 170.	2·5...3·0.
4. ‖ PERITOMOUS LEAD-BARYTE.	C. I. p. 170.	" "
5. ¶ SULPHATE OF LEAD	C. I. p. 170.	3·0.
6. ¶ CELESTINE.	C. I. p. 172.	3·0...3·5.
7. ¶ HEAVY SPAR.	C. I. p. 172.	" "
8. ¶ WHITE LEAD-ORE.	C. I. p. 172.	" "
9. ¶ ARRAGONITE.	C. I. p. 172.	3·5...4·0.
10. MANGANITE.	C. I. p. 174.	4·0...4·25.

VIII. ORDER.

Names.		Hardness.
1. ¶ GYPSUM.	C. I. p. 178.	1·5...2·0.
2. ¶ VIVIANITE.	C. I. p. 178.	2·0.
3. ¶ HEULANDITE.	C. I. p. 178.	3·5...4·0.

RIGHT RECTANGULAR PRISM.

Sp. Gravity.	
2·95.	
2.7...3·0.	
2·1...2·2.	
6·0...6·3.	

RIGHT RHOMBIC PRISM.

Sp. Gravity.	Inclination of M on M′, Fig. 30.
3·4...3·6.	100° 00′
4·2...4·6.	91 10
6·2...6·4.	137
7·07.	102 27
6·2...6·4.	103 42
3·6...4·0.	104
4·1...4·7.	101 42
6·3...6·6.	117 18
2·6...3·0.	116 10
4·38.	99 40

RIGHT OBLIQUE ANGLED PRISM.

Sp. Gravity.	Inclination of M on T, Fig. 31.
2·2...2·4.	113° 8′
2·6...2·7.	125 15
2·0...2·2.	130 30

Names.		Hardness.
4. ¶ WOLFRAM.	C. I. p. 178.	5·0...5·5.
5. ¶ EPIDOTE.	C. I. p. 180.	6·0...7·0.

IX. ORDER.

SECTION I.

Names.		Hardness.
1. REALGAR.	C. I. p. 180.	1·5...2·0.
2. ‖ GLAUBERITE.	C. p. p. 180.	2·5...3·0.
3. ¶ LAUMONITE.	C. I. p. 182.	1·5...5·5.
4. ¶ SPHENE.	C. I. p. 182.	5·0...5·5.
5. ¶ PYROXENE.	C. I. p. 182.	5·0...6·0.

SECTION II.

Names.		Hardness.
1. ¶ MICA.	C. I. p. 182.	2·0...2·5.
1. ¶ ANTHOPHYLLITE.	C. I. p. 184.	5·0...5·5.
? CUMMINGTONITE.		(" ")
2. ¶ HORNBLENDE. Carinthin. *Werner.*	C. 1. p. 184.	5·0...6·0.
3. ¶ SPODUMENE. *Prismatic Triphane-Spar.* M.		6·5...7·0.

APPENDIX.

A. ¶ PICROSMINE.		2·5...3·0.
B. ‖ PYRALLOLITE.	C. 1. p. 184.	3·5...4·0.
C. ¶ BRONZITE. *Hemi-Prismatic Schiller-Spar.* M.		4·0...5·0.
D. ¶ HYPERSTHENE. *Prismatoidal Schiller-Spar.* M.		6·0.

Sp. Gravity.	Inclination of M on T, Fig. 31.
7·1...7·4.	117° 22′
3·2...3·5.	115 40

OBLIQUE RHOMBIC PRISM.

OBLIQUE FROM AN ACUTE EDGE.

Sp. Gravity.	Inclination of M on M′ Fig. 32.
3·5...3·6.	74° 14′
4·19.	56
2·3...2·4.	86 15
3·4...4·4.	76 2
3·2...3·5.	87 5

OBLIQUE FROM AN OBTUSE EDGE.

Sp. Gravity.	Inclination of M on M′ Fig. 32.
2·8...3·0.	100° 0′
3·0...3·3.	125
2·8...3·2.	124 30
3·17.	93 94
2·66.	
2·5...2·6.	94 36
3·25.	94
3·38.	93

X. ORDER.

Names.		Hardness.
1. ‖ LATROBITE.	C. I. p. 186.	5·5.
2. ¶ FELDSPAR.	C. I. p. 186.	6·0.
3. PERIKLIN.	C. I. p. 186.	"
4. ¶ ALBITE.	C. I. p. 186.	"
5. ¶ FOWLERITE.	C. I. p. 186.	"
6. ¶ KYANITE.	C. I. p. 188.	5·0...7·0.

APPENDIX.

A. ¶ TABULAR SPAR. *Prismatic Augite-Spar.* M.		4·0...5·0.

XI. ORDER.

SECTION I.

Names.		Hardness.
1. ‖ SULPHATO-TRI-CARBONATE OF LEAD.	C. I. p. 188.	2·5.
2. ¶ SPECULAR IRON.	C. I. p. 190.	5·5...6·5.
3. ¶ CORUNDUM.	C. I. p. 190.	9·0.

SECTION II.

Names.		Hardness.
1. RED SILVER.	C. I. p. 190.	2·0...2·5.
2. ¶ CALCAREOUS SPAR.	C. I. p. 190.	3·0.
3. ANKERITE.	C. I. p. 190.	3·5.
4. CARBONATE OF MANGANESE.	C. I. p. 192.	"
5. ¶ DOLOMITE.	C. I. p. 190.	4·0.
6. ¶ SPATHIC IRON.	C. I. p. 194.	4·0...4·25.
7. ¶ RHOMB SPAR.	C. I. p. 194.	4·0...4·5.

DOUBLY OBLIQUE PRISM.

Sp. Gravity.	P on M.	P on T.	M on T.
2·7...2·8.	91° 0′	98° 30′	93° 30′
2·5...2·6.	90 0	120 15	112 45
2·54...2·56.	93 19		114 45
2·6...2·68.	93 30	117 53	115 5
3·5...3·8.	95 0	121 0	113 0?
3·6...3·7.	93 15	100 50	106 15
2·8.	126 0	93 40	95 15

RHOMBOID.

ACUTE.

Sp. Gravity.	Inclination of P on P′, Fig. 40.
6·3...6·5.	72° 30′
4·8...5·3.	86 10
3·9...4·0.	86 4

OBTUSE.

Sp. Gravity.	Inclination of P on P′, Fig. 40.
5·4...5·9.	109° 56′
2·5...2·8.	105 5
2·9...3·1.	106 12
3·3...3·6.	106 51
3·0...3·2.	106 15
3·6...3·9.	107 0
3·0...3·11.	107 22

CLASS III.

ABBREVIATIONS EMPLOYED IN I. ORDER.

Ad.	for	adamantine.	Met.	for	metallic.
Bot.	"	botryoidal.	Reni.	"	reniform.
Capil.	"	capillary.	Res.	"	resinous.
Col.	"	columnar.	Stalac.	"	stalactitic.
Comp.	"	composition.	T.	"	taste.
Frac.	"	fracture.	Translu.	"	translucent.
Glob.	"	globular.	Transpa.	"	transparent.
Gran.	"	granular.	Var.	"	varieties.
Impal.	"	impalpable.	Vit.	"	vitreous.
Lam.	"	lamellar.			

I. ORDER.

Names.	Hardness.	Sp. Grav.
1. ‖ SASSOLIN.		
Prismatic Boracic-Acid. M.		
Boracic Acid.	1·0.	1·48.
2. ‖ ALUMINITE.		
Sub-Sulphate of Alumine.		
Websterite. *Brongniart.*	"	1·66.
3. ‖ MEERSCHAUM.		
Sea-foam.	"	1·6.
? PHOLERITE. *Guillemin.*		
? LENZINITE. *Johns.*	"	(1·8...2·10)
4. ‖ HUMBOLDTINE.		
Oxalate of Iron.	"	1·0...2·5.
5. ‖ ANTIMONY-PHYLLITE.		
Diatomous Antimony-Phyllite. Breithaupt.	"	4·0.
6. NATRON.		
Hemi-prismatic Natron-Salt. M.		
Carbonate of Soda.	1·0...1·5.	1·42.
7. PRISMATIC NATRON-SALT.		1.56
? TRONA. *Hausmann.*	1·5.	
8. ¶ TALC. C. I. p. 196.	" "	2·7...2·8.
9. ‖ KUPFERSCHAUM. C. I. p. 168.	" "	3·09.
10. ‖ STERNBERGITE. C. I. p. 168.	" "	4·21.
11. ¶ SULPHURET OF MOLYBDENA. C. I. p. 196.	" "	4·4...4·6.
12. ‖ RED ANTIMONY.		
Prismatic Purple-Blende. M.	" "	4·5...4·6.
13. HORN SILVER. C. I. p. 154.	" "	5.5.
14. ‖ BLACK TELLURIUM. C. I. p. 162.	" "	7·0...7·5.
15. OXIDE OF ARSENIC. C. I. p. 156.	1·5.	3·6...3·7.
16. ¶ NATIVE MAGNESIA. C. I. p. 196.	1·0...1·75.	2·35.
17. ¶ BITUMEN.		
Black Mineral Resin. M.		
Mineral Pitch. *Phillips.*		
Asphalt. *Leonhard.*		
Mineral Caoutchouc.	1·0...2·0.	0·68...1·6.

SOLIDS.			
Lustre.	Color.	Streak.	Various Observations.
Pearly.	Yellowish-white.		T. acidulous, becoming bitter & finally sweet.
Dull.	White.		In reni. masses, opake.
Dull.	White.		Rather greasy to the feel.
(Nacreous.)	(White.)		(In slightly convex scales.)
(Dull.)	(White.)		(Translucent.)
Dull.	Ochre-yellow.		In small flattish masses.
Pearly.	Greyish-white.		Translucent: greasy to the feel.
Vitreous.	White.		T. pungent alkaline.
Vitreous.	White.		T. pungent alkaline.
Pearly.	Green and white.		Greasy to the feel.
Vit. & pearly.	Apple-green, sky-blue.		Very sectile. Thin laminæ flexible: in reni. and bot. shapes.
Metallic.	Bronze.	Black.	
Metallic.	Lead-grey.	Lead-grey.	Thin laminæ, highly flexible, very sectile.
Met. ad.	Cherry-red.	Cherry-red.	Tufts of capil. crystals, or fibres straight, and divergent from common centres.
Adamantine.	Brown; where exposed to light, black.	Shining.	
Metallic.	Blackish lead-grey		
Vitreous, inclining to ad.	White.		Translucent to opake.
Pearly.	White.		Transl. opake where exposed to the open air. Thin laminæ flexible.
Resinous.	Reddish-brown to black.		Sectile, elastic: after exposure to the air, brittle.

	Names.		Hardness.	Sp. Grav.
18.	‖ NAPHTHALINE.	C. I. p. 162.	1·0...2 0.	1·5.
19.	¶ PLUMBAGO.	C. I. p. 196.	" "	1·8...2·1.
20.	‖ HORN QUICKSILVER.	C. I. p. 162.	" "	6·4...6·5.
21.	‖ RETINITE.			
	Retinasphalt. *Phillps.*		1·5...2·0.	1·35.
22.	GLAUBER SALT.			
	Prismatic Glauber-Salt. M.			
	Sulphate of Soda.		1·5...2·0.	1·48.
23.	‖ SAL AMMONIAC.	C. I. p. 156.	" "	1·5...1·6.
24.	SULPHATE OF ALUMINE.			
	Native Soda Alum. *Thomson.*		" " ?	1·88.
25.	SULPHUR.	C. I. p. 162.	" "	1·9...2·1.
26.	NITRATE OF SODA.		" "	2·09.
27.	¶ GYPSUM.	C. I. p. 178.	" "	2·2...2·4·
28.	‖ COBALT BLOOM.	C. I. p. 178	" "	2·94.
29.	ORPIMENT.	C. I. p. 168.	" "	3·4...3·6.
30.	REALGAR.	C. I. p. 180.	" "	3·5...3·6.
31.	‖ GRAPHIC GOLD.	C. I. p. 168.		5·7...5·8·
32.	‖ NATIVE LEAD.			
33.	‖ YELLOW TELLURIUM.			
	Yellow Gold Glance. *Jameson.*			10·6.
34.	‖ KONIGENE.	C. I. p. 168.	2·0.	
35.	¶ COPPERAS.	C. I. p. 180.	"	1·9.
36.	‖ GAY LUSSITE.	C. I. p. 180.	"	1·9.
37.	¶ NITRE.			
	Prismatic Nitre-Salt. M.			
	Nitrate of Potash.		"	1.9...2·0.
38.	‖ BOTRYOGENE.	C. I. p. 168.	"	2·03.
39.	DERMATINE.		"	2·13.
40.	COMMON SALT.	C. I. p. 154.	"	2·25.
41.	¶ VIVIANITE.	C. I. p. 178.	"	2·6...2·7.

Lustre.	Color.	Streak.	Various Observations.
Resinous.	Greenish and yellowish-white.		Transpa. and brittle.
Metallic.	Iron-black.	Shining.	Laminæ very flexible.
Adamantine.	Greyish or yellowish-white.	White.	
Resinous.	Green, yellow, red and brown.		Fracture conchoidal: in roundish masses.
Vitreous.	White.		Efflorescent. In mealy crusts. Taste cool, saline and bitter.
Vitreous.	White or grey.		T. acute and pungent: in a mealy powder.
Vitreous.	Colorless.		In silky crystals, fibrous masses & white powder. Taste like alum.
Resinous.	Yellow.		Brittle.
Vitreous.	Colorless.		Taste cooling.
Vit. & pearly.	White in most cases.	White.	Sectile.
Vitreous ad.	Peach-blossom-red.	Pale red.	In glob. & reni. shapes. Comp. columnar.
Met. pearly.	Lemon-yellow.		Sectile. Faces of comp. streaked.
Resinous.	Aurora-red.	Orange yellow to red.	Sectile.
Metallic.	Steel-grey.		Massive varieties imperfectly col. or gran.
Metallic.			
Metallic.	Silver-white inclining to yellow.		
Vitreous?	Emerald or blackish-green.		
Vitreous.	Green to white.		Massive varieties pulverulent. T. sweetish astringent.
Vitreous.	Colorless or greyish white.		Transpa. or translu.
Vitreous.	Colorless.		T. saline. In crystals and flakes; rarely col.
Vitreous.	Hyacinth red to ochre-yellow.		In reni. and bot. shapes. T. feebly astringent.
Greasy.	Green or dark brown.		Kidney-shaped, or glob. pieces. Frac. conchoidal. Translu.
Vitreous.			Saline.
Vit. & pearly.	Blackish-green and indigo-blue.	Bluish-white.	Massive var. in small reni. and glob. shapes; also in superficial coatings of dusty particles.

Names.		Hardness	Sp. Grav.
42. ‖ COPPER MICA.	C. I. p. 188.	2·0.	2·5...3·2.
43. ¶ GREY ANTIMONY.	C. I. p. 168.	2·0.	4·2...4·6.
44. ¶ BITUMINOUS COAL. *Bituminous Mineral-Coal.* M. Black Coal. Brown Coal. Cannel Coal. Jet. Slate Coal. Bituminous Wood. Paper Coal.		1·0...2·5.	1·2...1·4.
45. ¶ AMBER. *Yellow Mineral Resin.* M.		2·0...2·5.	1·08.
46. ‖ MELLITE.	C. I. p. 160.	" "	1·59.
47. BORAX.	C. I. p. 182.		1·76.
48. ¶ EPSOM-SALT.	C. I. p. 168.	" "	1·7...1·8.
49. ¶ ALUM. *Octahedral Alum-Salt.* M.		" "	" "
50. KEROLITE.		2·0...2·5.	2·0.
51. ‖ PYRORTHITE.		" "	2·19.
52. ‖ WHITE VITRIOL.	C. I. p. 168.	" "	2·0...2·1.
53. ¶ MICA.	C. I. p. 132.	" "	2·0...2·5·
54. ¶ PINITE.	C. I. p. 190.	" "	2.7.
55. ‖ THENARDITE.	C. I. p. 170.	" "	2·7.
56. FIGURE-STONE. Agalmatolite.		" "	2·81.
57. ‖ HAIDINGERITE.	C. I. p. 170.	" "	2·8...3·0.
58. ‖ LENTICULAR COPPER-ORE.	C. I. p. 162.	" "	" "
59. ‖ URANITE.	C. I. p. 164.	" "	3·0. .3·2.
60. ‖ CRONSTEDITE.	C. I. p. 190.	" "	3·34.
61. ¶ PYROLUSITE.	C. I. p. 170.	" "	4·8...4·9.
62. ‖§ MYARGYSITE.	C. I. p. 170.	" "	5·23.

Lustre.	Color.	Streak.	Various Observations.
Pearly.	Emerald and grass-green.		Sectile. Massive varieties, gran. uneven and rough.
Metallic.	Lead-grey.	Lead-grey.	Capil. crystals very minute. Comp. sometimes fine granular.
Resinous.	Black or brown.		Comp. lam. gran. impal. and fibrous.
Resinous.	Yellow to red.	White.	Fracture conchoidal, transpa. or translu. Res. electricity produced by friction.
Res. to vit.	Honey-yellow.	White.	Massive varieties in nodules; comp. gran.
Res. and dull.	White.		T. sweetish alcaline.
Vit. pearly or dull.	White.		Bot. & reni. Particles of comp. very delicate, sometimes pulverulent.
Vit. pearly or dull.	White.		Fibrous, impal. or mealy
Vit. faint.	White & greenish.	White.	Frac. conchoidal.
Resinous.	Brownish-black.	Brownish-black.	Opake. Frac. splintery.
Pearly or dull.	White.		Reni. & stalac. Comp. col. & gran. T. nauseous and metallic.
Pearly.	Various.		Comp. col. gran. faces of comp. irregularly streaked and rough.
Res. faint.	Blackish-green & greenish-grey.	Grey.	Sectile.
Vit. dull after exposure to the air.	White.		Pulverulent after exposure to the air. T. cooling.
Dull.	Grey, yellow, and reddish.	White and shining	Comp. impal., fracture uneven.
Vitreous.	White.		
Vitreous.	Sky-blue to green.		Composition granular.
Ad. or pearly.	Emerald, grass or leek-green.		Composition granular.
Vitreous.	Brownish-black.	Dark leek-green.	Opake. Reni. Comp. columnar.
Metallic.	Iron-black.	Black.	Opake. In reni. coats. Comp. col. and gran.
Between met. and met. ad.	Iron-black.	Dark cherry-red.	Opake except in thin splinters.

Names.		Hardness	Sp. Grav.
63. RED SILVER.	C. I. p. 190.	2·0...2·5.	5·4...5·9.
64. JAMESONITE.	C. I. p. 170.	" "	5·56.
65. ‖ BI-SELENIURET OE ZINC.		" "	5·56.
66. ‖ SELENIURET OF LEAD.		" "	
67. BLACK SILVER.	C. I. p. 170.	" "	5·9...6·4.
68. ‖ NATIVE TELLURIUM.	C. I. p. 190.	" "	6·1...6·2.
69. ‖ SULPHURET OF BISMUTH.		" "	6·54.
70. ¶ WHITE LEAD ORE.	C. I. p. 172.	" "	6·3...6·6.
71. VITREOUS SILVER.	C. I. p. 154.	" "	7·19.
72. § BLUE VITRIOL.	C. I. p. 184.	2·5.	2·2...2·3.
73. ‖ COBALT BLOOM.	C. I. p. 178.	"	2·9...3·1.
74. ‖ CRONSTEDITE.		"	" "
75. ¶‖§ CORNEOUS LEAD.	C. I. p. 164.	"	6·05.
76. ‖ CHROMATE OF LEAD.	C. I. p. 182.	"	6·0...6·1.
77. ‖ POLYBASITE.	C. I. p. 190.	"	6·2.
78. ‖§ SULPHATO-TRI-CARBONATE OF LEAD.	C. I. p. 188.	"	6·3...6·5.
79. ¶ GALENA.	C. I. p. 154.	"	7·4...7·6.
80. ¶ LAUMONITE.	C. I. p. 182.	1·5...5·5?	2·3...2·4.
81. ‖ NATIVE AMALGAM.	C. I. p. 156.	1·5...3·0.	10·5...12·5.
82. ‖ SULPHATE OF POTASH.		2·5...3·0.	1·73.
83. ¶ CHRYSOCOLLA. *Uncleavable Staphyline-Malachite.* M.		" "	2·0...2·2.
84. ¶ MARMOLITE.		" "	2·47.
85. ¶ PICROSMINE. Asbestus.		" "	2·5...2·6.

Lustre.	Color.	Streak.	Various Observations.
Met. ad.	From iron-black to cochineal-red.	Streak like the color.	Comp. gran., strongly connected, sometimes impal., also in plates and coatings.
Metallic.	Steel-grey.	Steel-grey.	
Metallic.	Dark lead-grey.	Blackish lead-grey.	Composition granular?
Metallic.	Bluish-grey.	Blackish-grey	Comp. finely granular.
Metallic.	Iron-black.	Iron-black.	Comp. gran. strongly connected. Fracture uneven.
Metallic.	Tin-white.	Tin-white.	Comp. gran., fine.
Metallic.	Lead-grey.	Lead-grey.	Comp. gran. or col.
Ad. to res., sometimes pearly.	White passing to grey.	White.	Comp. col. and impal.
Metallic.	Blackish lead-grey	Shining.	Malleable. Reticulated, arborescent and capil., massive: comp. impalpable.
Vitreous.	Sky-blue.	White.	Taste astringent.
Ad. to vit.	Crimson-red to grey.		In glob. and reniform shapes: comp. col. also pulverulent.
Vitreous.	Brownish black.	Dark leek-green.	Opake. In reniform masses. Comp. col.
Adamantine.	White with pale tints of grey and green.	White.	Transpa. or translu.
Adamantine.	Hyacinth-red.	Orange-yellow.	
Metallic.	Iron-black.	Iron-black.	Sectile.
Res. to splendent, ad.	Pale greenish, yellowish or brownish white.	White.	Comp. lam. or gran.
Metallic.	Lead-grey.	Lead-grey.	Composition granular.
Vit. to pearly.	Greyish or reddish white.	White.	Comp. gran. or imperfectly columnar.
Metallic.	Silver-white.	Silver-white.	Comp. impal. Frac. conchoidal.
Vitreous.	White to grey.		Bitter & disagreeable.
Vitreous.	Emerald, pistachio and asparagus-green to sky-blue	White.	Transpa. Comp. impal. Frac. conchoidal.
Pearly.	Greenish yellow.	White.	Comp. lam. Individuals large and curved.
Pearly to vit.	Greenish white.	White.	Sectile. Comp. gran. & col. strongly coherent: in delicate fibres.

	Names.		Hardness	Sp. Grav.
86. ‖§	HOPEITE.	C. I. p. 170.	2·5...3·0.	2·7.
87. ‖	GLAUBERITE.	C. I. p. 180.	" "	2·7...2·8.
88. ‖	CRYOLITE.	C. II. p. 204.	" "	2·9...3·0.
89. ‖§	RADIATED ACICULAR OLIVINITE.	C. I. p. 180.	" "	4·19.
90. ‖	CUPREOUS SULPHATO CARBONATE OF LEAD.	C. I. p. 170.	" "	5·3...5·43.
91. ¶	VITREOUS COPPER.	C. I. p. 188.	" "	5·5...5·8.
92. ‖	BOURNONITE.	C. I. p. 166.	" "	5·7...5·8.
93. ‖	WHITE ANTIMONY.	C. I. p. 170.	" "	6·2...6·4.
94.	PERITIMOUS LEAD-BARYTE.	C. I. p. 170.	" "	7.07.
95. ¶	NATIVE COPPER.	C. I. p. 154.	" "	8·4...8·9.
96. ¶	NATIVE SILVER.	C. I. p. 154.	" "	10·0...10·5.
97. ¶	NATIVE GOLD.	C. I. p. 156.	" "	12·0...20·0.
98. ¶	ANTHRACITE. *Non-Bituminous Mineral-Coal.* M. Mineral Carbon, Blind Coal.		3·0.	1·4...2·0.
99.	ALLOPHANE.		"	1·8...1·9.
100. ¶	SERPENTINE.	C. I. p. 168.	"	2·5.
101. ¶	DEWEYLITE. Siliceous Hydrate of Magnesia.		"	2·2...2·3.
102. ¶	CALCAREOUS SPAR. Anthrakonite. *Hausmann.*	C I. p. 190.	"	2·5...2·8.
103.	ANKERITE.	C. I. p. 192.	"	2·9...3·1.
104.	PRISMATIC OLIVINITE.	C. I. p. 170.	"	4·2...4·6.
105. ‖	THORITE.		"	4·6.
106. ¶	PURPLE COPPER.	C. I. p. 156.	"	4·9...5·0.

Lustre.	Color.	Streak.	Various Observations.
Vit. & pearly.	Greyish white.	White.	Sectile.
Vitreous.	Yellowish or greyish white.	White.	Semi-transpa. Brittle. Saline.
Vit. inclining to pearly.	White.	White.	Translucent.
Pearly.	Verdigris-green to sky-blue.	Verdigris-green.	Not very brittle.
Resinous.	Deep verdigris-green.	Greenish white.	Translucent.
Metallic.	Blackish lead-grey	Shining.	Sectile; comp. fine gran. or impal.
Metallic.	Steel-grey.	Steel-grey.	Brittle; comp. gran.
Ad. to pearly.	White, rarely reddish grey.	White.	Comp. gran., lam. or columnar.
Ad. to pearly.	Yellowish white or pale rose-red.		Translucent.
Metallic.	Copper-red.	Copper-red: shining.	In arborescent and filiform shapes.
Metallic.	Silver-white.	Silver-white: shining.	Ductile; dentiform, filform and capillary shapes; also arborescent, and in plates.
Metallic.	Gold-yellow.	Shining.	Filiform, capil., reticulated and arborescent shapes; also in leaves and membranes.
Imperfect metallic.	Iron-black	Iron-black.	Comp. lam., but oftener impalpable.
Vit. to res.	Blue, green and grey.		Reni. and bot.; comp. impalpable.
Res. faint.	Some shade of green.		Sectile. Comp. gran. and impal., veined & spotted.
Vit. to resinous, faint.	White, tinged by green and red.	White.	Comp. impal. Frac. even: easily frangible
Vit. inclining to pearly.	Various.	White.	Comp. col. gran. lam. and impalpable.
Vit. inclining to pearly.	White, with tints of red, grey and brown.	White.	Composition granular.
Adamantine.	Various shades of green.	Olive-green.	Glob. shapes. Comp. columnar: fine and divergent.
Resinous and shining.	Black.	Brownish red.	Very brittle.
Metallic.	Copper-red to pinchbeck-brown	Greyish black	Comp. gran., strongly connected.

Names.		Hardness.	Sp. Grav.
107. PRISMATIC ANTIMONY-GLANCE. *Prismatoidal Copper Glance.* M.		3.	5·73.
108. ‖ POLYSPHÆRITE.		"	5·8.
109. ¶‖ SULPHATE OF LEAD.	C. I. p. 170.	"	6·2...6·4.
110. ¶‖ MOLYBDATE OF LEAD.	C. I. p. 160.	"	6·5...6·9.
111. ‖§ HERSHELITE.	C. I. p. 196.	3·0...3·5.	2·1.
112. ‖ POLYHALLITE.		" "	2·7.
113. ¶ ANHYDRITE.	C. I. p. 166.	" "	2·7...3·1.
114. ‖§ WAGNERITE.	C. I. p. 182.	" "	3·1.
115. ¶ CELESTINE.	C. I. p. 172.	" "	3·6...4·0.
116. ‖ ATACAMITE.	C. I. p. 172.	" "	4·0...4·3.
117. ¶ HEAVY SPAR.	C. I. p. 172.	" "	4·1...4·7.
118. ‖ HEDYPHANE.		" "	5·40.
119. WITHERITE.	C. I. p. 172.	" "	6·3...6·6.
120. ¶ WHITE LEAD-ORE.	C. I. p. 172.	" "	" "
121. ‖ NATIVE ANTIMONY. *Rhombohedral Antimony.* M.		" "	6·5...6·8.
122. ¶‖ GIBBSITE. Hydrate of Alumine.		3·5.	2·4.
123. ‖ ROSELITE.	C. I. p. 178.	"	2·64.
124. ‖ CARBONATE OF MANGANESE.	C. I. p. 192.	"	3·3...3·5.
125. ‖ STRONTIANITE.	C. I. p. 172.	"	3·6...3·8.
126. ‖ ZINKENITE. Haidingerite. *Berthier.* Berthierite. *Haidinger.*	C. I. p. 196.	"	5·3.
127. ‖ NATIVE ARSENIC. *Native Arsenic.* M.		"	5·7...5·8.

Lustre.	Color.	Streak.	Various Observations.
Metallic.	Blackish lead-grey.	Blackish lead-grey.	Brittle. Comp. gran. strongly connected.
Greasy.	Clove-brown and yellowish grey.		In rounded balls made up of concentric layers.
Ad. to res.	Yellowish, greyish or greenish white.	White.	Comp. lamellar: often strongly connected.
Resinous.	Wax-yellow.	White.	Comp. gran., strongly coherent.
	White.		Terminal faces of the crystals dull & curved. Fracture conchoidal.
Resinous.	Grey to red.		Composition columnar.
Vitreous.	White, or tinged with pink or blue.	Greyish white	Translu. Comp. col., granular, sometimes impalpable.
Vitreous.	Yellow.	White.	Translucent.
Vitreous.	White tinged with blue.	White.	Brittle. Comp. lam., col. and gran.
Vitreous.	Grass and emerald green.	Apple-green.	Reniform. Comp. col., also in the form of sand.
Vit. to res.	Grey to blue, yellow and white.	White.	Glob. and reni. shapes. Comp. lam. col. or granular.
Ad. greasy.	Greyish-white.		Comp. gran. and impal.
Vit. or res.	White or yellowish grey.	White.	Composition columnar.
Ad. to res.	White to grey.		Comp. col., but oftener gran.: rarely impal.
Metallic.	Tin-white.		Comp. of flat grains collected into curved lamellæ, or granular.
Feeble.	Greyish white.		In irregular stalac. and tuberous masses. Comp. col. The fibres scarcely perceptible.
Vitreous.	White or pink.		In capil. fibres, having a glob. aggregation.
Vitreous.	Rose-red.	White.	Glob. shapes. Comp. gran. col. and impal.
Vit. to res.	Greenish white & yellowish brown.	White.	Comp. col., divergent.
Metallic.	Steel-grey.	Steel-grey.	
Metallic.	Tin-white to lead-grey.	Shining.	In reni. and stalactitic shapes. Composition gran. and impalpable.

Names.		Hardness.	Sp. Grav.
128. ANTIMONIAL SILVER.		3·5.	8·9...10·0.
129. ¶ MAGNESITE.	C. I. p. 192.	3·0...4·0.	2·8...2·9.
130. FAHLERZ.	C. I. p. 156.	" "	4·4...5·2.
131. ¶ RED OXIDE OF COPPER.	C. I. p. 156.	" "	5·6...6·0.
132. || PYRALLOLITE.	C. II. p. 184.	3·5...4·0.	2·0.
133. ¶ STILBITE.	C. I. p. 166.	" "	2·0...2·2.
? MESOLE. *Berzelius.*		(3·5.)	(2·37.)
134. ¶ HEULANDITE.	C. I. p. 172.	" "	2 0...2·2.
135. WAVELLITE.	C. I. p. 172.	" "	2·33.
136. ¶ SCHILLER-SPAR. *Diatomous Schiller-Spar.* M.		" "	2·6...2·8.
137. || KARPHOLITE.		" " ?	2·93.
138. ¶ ARRAGONITE.	C. I. p. 172.	" "	2·6...3·0.
139. ||§ EUCHROITE.	C. I. p. 172.	" "	3·0.
140. ||§ SCORODITE.	C. I. p. 172.	" "	3·0...3·2.
141. ||§ BROCHANTITE.	C. I. p. 172.	" "	
142. ¶ BLUE MALACHITE.	C. I. p. 182.	" "	3·7...3·9.
143. ¶ GREEN MALACHITE.	C. I. p. 182.	" "	3·6...4·5.
144. SULPHURET OF MANGANESE. *Hexahedral Glance-Blende.* M.		" "	4·01.
145. ¶ YELLOW COPPER PYRITES.	C. I. p. 160.	" "	4·1...4·3.
146. ¶ BLENDE.	C. I. p. 158.	" "	4·5...4·8.

Lustre.	Color.	Streak.	Various Observations.
Metallic.	Silver to tin-white.	Silver-white.	Composition granular.
Dull.	Yellowish or greyish white.	White.	Comp. impal. adheres to the tongue.
Metalilc.	Steel-grey to iron-black.	Brownish grey or black	Comp. gran., strongly connected: often impalpable.
Ad. or imperfect met.	Between cochineal-red & lead-grey.	Brownish red and shining.	Brittle. Comp. gran. impalpable, sometimes earthy.
Res. faint.	Greenish white.	White.	Composition granular: fracture earthy.
Vit. & pearly.	White, brown and red.	White.	Implanted globules. Comp. imperfectly col. & strongly cohering.
	(White.)		(Implanted globules. Comp. broad col., radiating from a centre.)
Vit. & pearly.	White, red and grey.	White.	Comp. gran. of various sizes, and strongly cohering.
Between pearly & vit.	White, green, yellow and grey.		Implanted globules: composition thin col. and radiating.
Met. pearly & faintly vit.	Olive and blackish green to pinch-beck-brown.	Greyish white	Rather sectile. Comp. gran. of various sizes.
Silky.	Bright straw-yellow.		Comp. thin col. scopiform and stellular.
Vit. to res.	White to yellow, green and blue.	Greyish white	Glob. and coralloidal shapes. Comp. col. delicate, parallel, or
Vitreous.	Emerald-green.	Pale apple-green.	divergent.
Vit., resinous within.	Leek-green to olive-green.	White.	Semi-transparent to translucent.
	Emerald-green.		Transparent.
Vit., almost adamantine.	Azure, blackish, & Berlin-blue.	Streak paler.	Glob. bot. and stalac. Comp. col., rarely granular.
Ad. to vit.	Grass, emerald & verdigris-green.	Streak paler.	Tuberose, botryoidal & stalac. shapes. Comp. col. rarely impal.
Imperfect metallic.	Iron-black.	Dark green.	Composition granular.
Metallic.	Brass-yellow.	Greenish black.	Rather sectile. Comp. impalpable. Fracture flat-conchoidal.
Adamantine.	Reddish brown, black, yellow and green.	White to reddish brown.	Comp. curved lam. col. gran. and impal.

Names.		Hardness.	Sp. Grav.
147. ARSENIATE OF LEAD.	C. I. p. 196.	3·5.. 4·0.	5·0...6·4.
148. ¶ PYROMORPHITE.	C. I. p. 196.	" "	6·9...7·3.
149. ¶ GREEN LEAD-ORE.	C. I. p. 198.	" "	6·9...7·3 ?
150. ‖ MARGARITE.		3·5...4·5.	3·0...3·1.
151. ¶ MAGNETIC IRON PYRITES.	C. I. p. 198.	" "	4·4...4·7.
152. ¶ DOLOMITE.	C. I. p. 192.	4·0.	3·0...3·2.
153. ¶ FLUOR.	C. I. p. 156.	"	3·0 ..3·3.
154. ‖§ BARYTO-CALCITE.	C. I. p. 184.	"	3·6.
155. ‖§ LIBETHENITE.	C. I. p. 172.	"	3·6...3·8.
156 ‖§ LEVYNE.	C. I. p. 188.	"	
157. TENNANTITE.	C. I. p. 156.	"	4·2...4·4.
158. ‖ TIN-PYRITES. Sulphuret of Tin.		"	4·35.
159. ¶ SPATHIC IRON.	C. I. p. 194.	4·0...4·25.	3·6...3·9.
160. MANGANITE.	C. I. p. 174.	" "	4·3.
161. ¶ CHABASIE.	C. I. p. 194.	4·0...4·5.	2·0...2·1.
162. ‖ OXAHEVRITE.	C. I. p. 160.	" "	" "
163. § PEGANITE.	C. I. p. 178.	" "	2·49.
164. ‖ PYROSMALITE. Muriate of Iron.		" "	3·0.
165. ¶ RHOMB SPAR.	C. I. p. 194	" "	3·0...3·1.
166. ¶ RED OXIDE OF ZINC. *Prismatic Zinc Ore.* M.		" "	5·4...5·5.
167. ¶ TUNGSTEN.	C. I. p. 160.	" "	6·0...6·1.
168. NATIVE PLATINA. *Native Platina.* M.		" "	16·0...20·0.
169. ‖§ BEUDANTITE.		4·5.	
170. ‖ HARMOTOME.	C. I. p. 166.	"	2·3...2·4.
171. ‖ OSMELITE.		"	2·7.. 2·8.

Lustre.	Color.	Streak.	Various Observations.
Resinous.	Hair-brown.		Bot. Comp. col and impalpable.
Res. and dull.	Brown.	Greyish white	Comp. col. and gran.
Resinous.	Green.	Yellowish white.	Comp. col. and gran.
Pearly.	Pearl-grey to white.	White.	Rather brittle. Comp. gran. of various sizes.
Metallic.	Between bronze-yellow and copper-red.	Dark greyish black.	Brittle. Slight action on the magnetic needle.
Vit. to pearly.	White, grey and brown.	White.	Glob. and bot. shapes. Comp. granular.
Vitreous.	Various.	White.	Brittle.
Vit. to res.	Greyish, yellowish or greenish white	White.	Transpa. or translu.
Resinous.	Dark olive-green.	Olive-green.	Translu. on the edges.
Vitreous.	White.	White.	Semi-transparent.
Metallic.	Blackish lead-grey	Reddish grey.	Opake. Brittle. Comp. gran. impalpable.
Metallic.	Steel-grey inclining to yellow.	Black.	Comp. gran. strongly coherent.
Vit. inclining to pearly.	Yellowish grey & reddish-brown.	White.	Brittle. Comp. col., gran. and impal.
Imperfect metallic.	Brownish black inclining to iron-black.	Reddish brown.	Minute splinters translucent. Comp. col., rarely granular.
Vitreous.	White.		Semi-transpa. Comp. granular.
Vitreous?	Light grey, green & reddish brown.		Composition granular.
Vit., greasy within.	Emerald, pistachio and grass-green.	White.	Transparent or translu.
Pearly.	Grey and green.	White.	Comp. lam. Rather brittle
Vitreous.	Green, white and brown.	Greyish white	Translu. Comp. col. and granular.
Adamantine.	Blood-red.	Orange-yellow.	Comp. gran., strongly connected.
Vit. to ad.	White and yellowish white.	White.	Composition granular.
Metallic.	Steel-grey.		In small rolled masses.
Greasy.	Black.	Greenish grey	Crystals small, and closely aggregated.
Vitreous.	White, passing to yellow and red.	White.	Composition granular.
Vit. & pearly.	Greyish white and brown.		Translu. Comp. col., in thin fibres, stellularly arranged; when moist, emits an earthy odor.

Names.		Hardness	Sp. Grav.
172. ¶‖ NATIVE IRON.	C. I. p. 156.	4·5.	7·4...7·8.
173. ‖ KARPHOSIDERITE.		4·0...5·0.	2·5.
174. ¶ TABULAR SPAR.	C. II. p. 208.	" "	2·8.
175. ¶ BRONZITE.	C. II. p. 206.	" "	3·2.
176. APOPHYLLITE.	C. I. p. 161.	4·5...5 0.	2·2...2·5.
177. ‖§ TURNERITE.	C. I. p. 184.	" "	
178. ‖ ERINITE.		" "	4·04.
179. ‖ HYDROUS PHOSPHATE OF COPPER.	C. I. p. 180.	" "	4·2.
180. THOMSONITE.	C. I. p. 164.	5·0.	2·37.
181. ‖§ POONHALITE.	C. I. p. 174.	"	
182. ALUM STONE.	C. I. p. 194.	"	2·5...2·8.
183. ‖§ HERDERITE.	C. I. p. 188.	"	2·9.
184. ¶ APATITE.	C. I. p. 198.	"	3·33.
185. ‖§ DIOPTASE.	C. I. p. 194.	"	3·2...3·4.
186. ¶ CALAMINE.	C. I. p. 194.	5 0...5·25.	4·1...4·5.
187. ¶ ELECTRIC CALAMINE.	C. I. p. 174.	6·0.	3·3...3·6.
188. ‖§ PYROCHLOR.	C. I. p. 156.	4·5...5·5.	4·2.
189. ¶ MESOTYPE.	C. I. p. 174.	5·0...5·5.	2·0...2·3.
190. ‖§ COMPTONITE.	C. I. p. 166.	" "	
191. ‖§ BREWSTERITE.	C. I. p. 178.	" "	2·1...2·2.
192. ¶ SCAPOLITE.	C. I. p. 164.	" "	2·6...2·7.
193. ‖§ EUDYALITE.	C. I. p. 188.	" "	2·89.
194. ¶ DATHOLITE.	C. I. p. 174.	" "	2·9...3·0.
195. ‖ BOTRYOLITE.		" "	" " ?

Lustre.	Color.	Streak.	Various Observations.
Metallic.			
Vitreous.	Straw-yellow.		In delicate radiating fibres.
Vitreous.	White tinged with grey and red.		Comp. lam., longish & strongly coherent.
Met. pearly.	Leek-green, hair-brown and grey.	Like the color	Comp. gran.; but of tener lam., sometimes affording a metalloid appearance.
Vitreous.	White tinged with blue and red.	White.	Brittle. Comp. lam.
Adamantine.	Yellow, inclining to brown.	White.	Transpa. or translu.
Res. almost dull.	Emerald or grass-green.	Paler than the color.	In small crested aggregations.
Ad., inclining to vitreous.	Emerald or verdi-gris-green.	Pale green.	In reni. masses. Comp. imperfect col.
Vit. inclining to pearly.	White.		Transpa. or translu. Comp. columar.
Vitreous.	White.		Transparent. Comp. col. radiating.
Vitreous.	White tinged with red & grey.	White.	Comp. small gran., often impalpable.
Vitreous.	Yellowish and greenish white.	White.	Strongly translucent.
Vitreous.	White tinged with various colors.	White.	Composition granular.
Vit. inclining to resinous.	Emerald & black-ish green.	Green.	Transparent, or translucent.
Vit. inclining to ad.	White tinged with yellow, green & blue.	White.	Glob. and bot. shapes. comp. col., gran. & impal. Strongly cohering.
Vit. inclining to pearly.	White tinged with grey, green or brown.	White.	Stalac. and imitative shapes. Comp. gran., sometimes impal.
Vit. to ad.	Reddish brown.	Clear brown.	Opake.
Vitreous.	White.	White.	Glob. shapes; comp. col. delicate, radiating.
Vitreous.	White.	White.	Transparent.
Vitreous.	White to yellow-ish grey.		Transparent and translucent.
Vit. inclining to res. and pearly.	White to grey, green, red, and blue.	Greyish white	Comp. gran. and impal.: individuals strongly coherent.
Vitreous.	Brownish-red.	White.	Translu. on the edges.
Vitreous.	White to green & yellow.	White.	Composition granular.
Vitreous.	Greyish white.	White.	In bot. shapes of very thin individuals.

	Names.	Hardness.	Sp. Grav.
196. ‖	LAZULITE. C. I. p. 174.	5·0...5·5.	2·9...3·0.
197. ¶	ANTHOPHYLLITE. C. I. p. 184.	" "	3·0...3·3.
198. ‖	DIASPORE. C. I. p. 184.	" "	3·43.
199. ¶	SPHENE. C. I. p. 182.	" "	3·4...4·4.
200. ¶	MANGANESE SPAR. Siliceous Oxide of Manganese. *Phillips.* Rubinspath. Hydropite, Rhodonite, Photizite, Hornmangar. *Jasche* and *Germar.*	" "	3·5...3·6.
201. ¶	RBOWN IRON ORE. C. I. p. 174. Brown Hematite. Compact Clay-ironstone. Pea-ore.	" "	3·8...4·2.
202. ¶	PHOSPHATE OF MANGANESE.	" "	3·4...3·7.
	? HURAULITE.	(" ")	(2·27.)
	? HETEPOSITE.	(" ")	(3·5.)
203. ‖	CRICHTONITE. C. I. p. 190.	" "	4·6...4·7.
204.	ILMENITE. C. I. p. 194. Menakenite ? Iserine ?	" "	4·6...4·7.
205. ‖	BLACK MANGANESE. C. I. p. 160.	" "	4·7...4·8.
206. ‖	NICKELIFEROUS GREY ANTIMONY.	" "	6·45.
207. ¶	WOLFRAM. C. I. p. 178.	" "	7·1...7·4.
208. ¶	ARSENICAL IRON PYRITES. C. I. p. 174.	" "	7·2.
209.	COPPER NICKEL. *Prismatic Nickel Pyrites.* M. Arsenical Nickel. *Phillips.*	" "	7·5...7·7.
210. ¶	ANALCIME. C. I. p. 154.	5.5.	2 0...2·2.
211. ‖	GLAUCOLITE.	"	2·7...2·9.
212. ‖	LATROBITE. C. I. p. 186.	"	2·7...2·8.
213. ‖§	AMBLYGONITE. C. I. p. 184.	"	2·9...3·0.
214.	SAUSSURITE. Jade. *Saussure.* Dyskolite. *Breithaupt.* Variolite. *Werner.*	"	3·2...3·3.
215. ¶	TROOSTITE. C. I. p. 154.	"	4·0...4·1.
216. ¶	CHROMATE OF IRON. C. I. p. 158.	"	4·4...4·5.

Lustre.	Color.	Streak.	Various Observations.
Vitreous.	Azure-blue.	White.	Comp. granular, strongly connected.
Pearly inclining to met.	Yellowish grey & clove-brown.	White.	Composition columnar, divergent.
Vitreous.	Greenish grey.		Comp. lam. curved.
Adamantine to resinous.	Brown, yellow, grey and green.	White.	Composition granular or lamellar.
Vitreous.	Rose-red, brownish red.	White.	Comp. columnar, oftener gran. & impal.: strongly cohering.
Adamantine.	Brown.	Yellowish brown.	Glob. and stalac. shapes, comp. col. or impal.
Res. inclining to ad.	Blackish brown.	Yellowish grey.	Composition lamellar.
(Vitreous ?)	(Reddish.)		
(Greasy.)	(Greenish or bluish grey.)		(After exposure to the air its color is violet.)
Metallic.	Iron-black.		
Imperfect metallic.	Dark Iron-black.	Black.	Comp. lam. or impal.
Imperfect metallic.	Brownish black.	Reddish brown.	Comp. granular, finely connected.
Metallic.	Steel-grey to silver-white.		Brittle.
Met. ad.	Brownish black.	Reddish brown.	Comp. lam. and impal.
Metallic.	Silver-white to steel-grey.	Greyish black	Comp. col. divergent. also granular.
Metallic.	Copper-red.	Brownish black.	Comp. impal.
Vitreous.	White to grey and flesh-red.	White.	Composition granular, strongly cohering.
Vitreous.	Lavender-blue, to green.		Fracture splintery and uneven.
Vitreous.	Pale rose-red.	White.	
Vit. inclining to pearly.	Greenish white.	White.	Translucent.
Pearly to vit.	White to mountain-green.	White.	Comp. gran. to impal. strongly cohering. Frac. uneven, splintery.
Vitreous.	Greenish & greyish white.	White.	Semi-transparent. Composition granular.
Imperfect metallic.	Between iron and brownish black.	Brown.	Composition granular: strongly connected.

Names.	Hardness.	Sp. Grav.
217. ‖ CERITE. *Uncleavable Cerium-Ore.* M. Cerine. *Berzelius.*	5·5.	4·9.
218. NICKEL GLANCE.	"	6·0.
219. BRIGHT WHITE COBALT. C. I. p. 154.	"	6·1...6·3.
220. ‖ PITCHBLENDE. *Uncleavable Uranium-Ore.* M.	"	6·4...6·6.
221. ¶ BOLTONITE. Bi-silicate of Magnesia. *Thomson.*	5·0...6·0.	2·8...2·9.
222. ¶ HORNBLENDE. C. I. p. 184. Asbestus (in part). Amianthoid. Perthite. *Thomson.* Hydrous Anthophyllite. *Thomson.*	" "	2·8...3·2.
223. ‖§ ARFVEDSONITE. C. I. p. 184.	" "	2·8...3·2.
224. ¶ PYROXENE. C. I. p. 182. Asbestus (in part). Mussite.	" "	3·2...3·5.
225. PSILOMELANE. *Uncleavable Manganese-Ore.* Haidinger.	" "	4·1...4·2.
226. ‖ SODALITE. C. I. p. 158.	5·5...6·0.	2·2...2·3.
227. ‖§ BROOKITE.	" "	
228. LEUCITE. C. I. p. 154.	" "	2·4...2·5.
229. § WILLEMITE. C. I. p. 196.	" " ?	
230. ‖§ BABBINGTONITE. C. I. p. 184.	" "	
231. ISOPYRE.	" "	
232. ‖ ELAOLITE.	" "	2·5...2·6.
233. BLUE SPAR. *Prismatoidal Azure-Spar.* M. Blue Feldspar. *Phillips.*	" "	3·0...3·1.
234. ‖ GEHLENITE. C. I. p. 166.	" "	" "
235. ‖ BROOKITE: C. I. p. 174.	" "	
236. ‖§ ANATASE. C. I. p. 160.	" "	3·8...3·9.

Lustre.	Color.	Streak.	Various Observations.
Adamantine.	Between clove-brown and cherry-red.	White.	Comp. gran. & impal.
Metallic.	Steel-grey.		
Metallic.	Tin-white to steel-grey.	Greyish-black	Comp. gran., small and strongly connected.
Imperfect metallic.	Greyish, iron, or greenish black.	Black.	Comp. gran. & impal.
Vitreous.	Greyish white and yellowish grey.	White.	Composition granular.
Vitreous.	Green, brown and black.		Comp. gran. and col.: individuals long, parallel and diverging.
Vitreous?	Black.		
Vitreous.	Green inclining to brown and black.		Comp. lam. and gran.
Imperfect metallic.	Bluish and greyish black.	Brownish-black. Shining.	Opake. Reni., bot. & fruticose. Comp. gran. col. and impalpable.
Vitreous.	White, grey, greenish white, azure-blue.		Comp. gran., impal.
Met. ad.	Hair-brown, yellow and reddish tints.		
Vitreous.	Ash-grey, with a reddish and yellowish tinge.	White.	Composition granular.
Vitreous.	White.		Transparent.
Vitreous.	Black.		
Vitreous.	Greyish-black and velvet-black.	Greenish-grey.	Fracture conchoidal.
Resinous.	Duck-blue, green, red and brown.	White.	Translucent. Frac. conchoidal.
Vitreous.	Smalt-blue.	White.	Composition granular in large individuals.
Res. to vit.	Grey and greyish-yellow.	White.	
Met. ad.	Hair-brown.	Yellowish-white.	Translucent to Opake. Brittle.
Met. ad.	Dark-brown and indigo-blue.	White.	Composition granular.

Names.	Hardness.	Sp. Grav.
237. ¶‖ YENITE. C.I. p. 174.	5·5...6·0.	3·8...4·1.
238. ‖§ FERGUSONITE. C. I. p. 164.	" "	5·8.
239. ¶ MISPECKEL. C. I. p. 176.	" "	5·7...6·2.
240. ¶ FELDSPAR. C. I. p. 186.	6·0.	2·5...2·6.
241. ‖ NEPHELINE. C. I. p. 198.	"	" "
242. PERIKLIN. C. I. p. 186.	"	2·54...2·56.
243. ¶ ALBITE. C. I. p. 186.	"	2·6...2·68.
244. ANORTHITE. C. I. p. 186.	"	2·6...2·7.
245. ¶ LABRADORITE. C. I. p. 186.		
Indianite. *Bournon.*	"	2·69...2·76.
246. ‖ TURQUOISE.		
Calaite. Agaphite and Johnite. *Fischer.*	"	2·8...3·0.
247. ¶ HYPERSTHENE. C. II. p. 206.	"	3·38.
248. ¶ FOWLERITE. C. I. p. 186.	"	3·5...3·8.
249. ‖ ALLANITE. C. I. p. 180.	"	4·0.
250. ¶‖ COLUMBITE. C. I. p. 166.	"	6·0...6·3.
251. ¶ OPAL.		
Uncleavable quartz. M. Hyalite. Hydrophane. Menilite. Cacholong. Siliceous Sinter. Chloropal. *Bernhardi.* Fiorite. *Thomson.*	5·5...6·5.	1·9...2·2.
252. ¶ SPECULAR IRON. C. I. p. 190. Compact red Iron-ore. Scaly red Iron-ore. Clay Iron-ore. Reddle. Jaspery Iron-ore. Columnar and Lenticular Iron-ore.	" "	4·8...5·3.
253. ¶ MAGNETIC IRON-ORE. C. I. p. 155.	" "	" "
254. ¶ PETALITE. *Prismatic Petaline Spar.* M.	6·0...6·5.	2·4...2·5.
255. FAHLUNITE. C. I. p. 176.	" "	2·6...2·7.

Lustre.	Color.	Streak.	Various Observations.
Imperfect metallic.	Greenish to iron-black.	Black.	Comp. col., thin and straight: also granular and impalpable.
Imperfect metallic.	Brownish-black.	Pale-brown.	
Metallic.	Silver-white to steel-grey.	Greyish-black.	Comp. col., straight or divergent, and impal.
Vitreous.	White, grey, red, and green.	White.	Comp. lam., gran. and impalpable.
Vitreous.	White.	White.	Composition granular.
Vitreous.	White, tinged with red.	White.	Comp. gran. and lam.
Vit. inclining to pearly.	White to grey, red and green.	White.	Comp. lamellar, rarely granular.
Vitreous.	White.	White.	Translu. Comp. lam. Semi-transparent.
Vit. with iridescent tints.	Greyish and greenish-white, and bluish-black.	White.	Comp. gran.: individuals of various sizes, strongly cohering.
	Blue to green.	White.	Comp. impal. Frac. conchoidal.
Met. pearly.	Greyish or greenish-black.	Greenish-grey.	Composition gran. of considerable size.
Vitreous.	Rose-red.	White.	Composition granular, individuals large.
Imperfect metallic.	Brownish or greenish-black.	Greenish-grey.	Composition lamellar.
Imperfect metallic.	Iron-black.	Brownish-black.	Composition granular.
Vitreous.	Various: play of colors in some.	White.	Reni. and bot. shapes. Comp. impalpable. Frac. conchoidal.
Metallic.	Steel-grey and iron-black.	Reddish-brown.	Opake. Glob., reni., bot. & stalac. shapes. Comp. col., gran. and impalpable.
Metallic.	Iron-black.	Black.	Opake. Comp. gran. and impalpable.
Vitreous.	White with a tinge of pink or blue.		Comp. col. and impal. strongly coherent.
Vitreous.	Green, brown, & black	Greyish white	Comp. impalpable.

Names.		Hardness	Sp. Grav.
256. ‖§ HELVIN.	C. I. p. 156.	6·0...6·5.	3·1...3·3.
257. ¶ WHITE IRON PYRITES.	C. I. p. 176.	" "	4·6...4·9.
258. ¶ BRAUNITE.	C. I. p. 162.	" "	4·8.
259. ¶ IRON PYRITES.	C. I. p. 154.	" "	4·9...5·0.
260. ‖ MOHSITE.	C. I. p. 190.	" "	
261. ¶ FRANKLINITE.	C. I. p. 158.	" "	5·0...5·1.
262. ¶ BRUCITE. Chondrodite. *d'Ohrson.*		6·5.	3·1.
263. ¶ IDOCRASE.	C. I. p. 164.	"	3·1...3·4.
264. ¶ RUTILE.	C. I. p. 164.		
Nigrine ?		"	4·2...4·4.
265. ‖ OSTRANITE.	C. I. p. 176.	"	4·3...4·4.
266. ‖§ POLYMIGNITE.	C. I. p. 176.	"	4·8.
267. ‖ YTTRO-TANTALITE.		"	5·39.
268. ¶ KYANITE.	C. I. p. 188.	5·0...7·0.	3·6...3·7.
269. PITCHSTONE. *Empyrodox Quartz.* M. Obsidian. *Werner.* Sphaerulite. *Werner.* Pearl-stone. *Werner.* Marekanite. *Kirwan.* Pseudo-Chrysolite. *Klaproth.* Pumice Stone. *Werner.*		6·0...7·0.	2·2.. 2·4.
270. ¶ PREHNITE.	C. I. p. 176.	" "	2·8...3·0.
271. ¶ NEPHRITE. Jade. *Haüy.*		" "	2·9...3·0.
272. ¶ EPIDOTE.	C. I. p. 180.	" "	3·2...3·5.
273. ¶ TIN-ORE.	C. I. p. 160.	" "	6·3...7·1.
274. ‖ AXINITE.	C. I. p. 188.	6·5...7·0.	2·2...2·4.
275. ‖§ HUMITE.	C. I. p. 176.	" "	2·0...3·0.
276. ¶ SPODUMENE.	C. II. p. 206.	" "	3·0...3·1.
277. PERIDOT.	C. I. p. 166.	" "	3·3...3·8.

Lustre.	Color.	Streak.	Various Observations.
Vit. to res.	Yellow, or greenish-grey.	White.	
Metallic.	Bronze-yellow.	Greyish black	Glob. & stalac. shapes. Comp. columnar.
Imperfect metallic.	Dark brownish-black.	Dark brownish-black.	Comp. gran., individuals strongly coherent.
Metallic.	Bronze-yellow.	Brownish-black.	Comp. gran. sometimes impalpable.
Metallic.	Iron-black.		Brittle.
Metallic.	Iron-black.	Dark brown.	Composition granular.
Vit. to res.	Yellow to red and brown.	White.	Composition granular.
Vit. to res.	Brown, green and yellow.	White.	Composition columnar.
Met. ad.	Reddish-brown.	Pale brown.	Composition granular, strongly connected.
Vitreous.	Liver-brown.	Pale brown.	Fracture uneven.
Metallic.	Black.	Brown.	Fracture conchoidal.
Imperfect metallic.	Black.	Grey.	Composition granular.
Pearly inclining to vit.	White, tinged with blue & green.	White.	Comp. broad col.
Vit. and res.	Black, brown, red, yellow, green, grey and white.	White.	Comp. gran., strongly connected; often impal. Frac. uneven & conchoidal.
Vitreous.	Various shades of green.	White.	In reni. & glob. shapes. composition granular, strongly coherent.
Dull.	Leek-green to white.	White.	Comp. impal., very tough.
Vitreous.	Green and grey.	White.	Composition granular, rarely impalpable.
Adamantine.	Grey, yellow, red, brown & black.	Pale grey.	Comp. col. divergent; also gran. and impal.
Vitreous.	Clove-brown.	White.	Comp. lamellar, rarely gran. and impalpable.
Vitreous.	Yellow to reddish-brown.		Transpa. to translu.
Pearly & vit.	White, greyish, greenish and reddish-white.	White.	Composition lamellar, individuals large.
Vitreous.	Various shades of green.	White.	Comp. gran., individuals easily separated.

Names.		Hardness	Sp. Grav.
278. ‖ GADOLINITE.	C. I. p. 176.	6·5...7·0.	4·0...4·3.
279. ¶ GARNET.	C. I. p. 160.	6·5...7·5.	3·5...4·3.
280. ¶ QUARTZ.	C. I. p. 196.		
Rose Quartz. Prase. Siderite. Hornstone. Lydian Stone. Flint. Chalcedony. Carnelian. Jasper. Agate. Heliotrope. Chrysoprase. Plasma. Swimming-stone.		7·0.	2·5...2·7.
281. ‖§ BORACITE.	C. I. p. 156.	"	2·8...3·0.
282. ¶ IOLITE.	C. I. p. 198.	7·0...7·5.	2·5...2·6.
283. ¶ TOURMALINE.	C. I. p. 196.	" "	3·0...3·2.
284. ¶§ STAUROTIDE.	C. I. p. 176.	" "	3·3...3·9.
285. ‖§ GISMONDIN.	C. I. p. 166.	7·5.	
286. ¶§ ZIRCON.	C. I. p. 162.	"	4·5...4·7.
287. ‖§ EUCLASE.	C. I. p. 180.	"	2·9...3·1.
288. ¶ ANDALUSITE.	C. I. p. 176.	"	3·0...3·02.
289. ¶‖§ DYSLUITE.	C. I. p. 158.	"	4·0...4·6.
290. ¶ BERYL.	C. I. p. 198.	7·5...8·0.	2·6...2·8.
291. ¶ SILLIMANITE.	C. I. p. 184.	" "	3·2.
292. ¶ FIBROLITE.	C. I. p. 184.		
Bucholzite. *Brandes.*		" "	
293. ¶ TOPAZ.	C. I. p. 176.	8·0.	3·4...4·6.
294. ¶§ SPINELLE.	C. I. p. 158.	"	3·5...3·8.
295. ¶ AUTOMALITE.	C. I. p. 158.	"	4·1...4·3.
296. ¶§ CHRYSOBERYL.	C. I. p. 168.	8·5.	3·6...3·8.
297. ¶ CORUNDUM.	C. I. p. 190.	9·0.	3·9...4·05.
298. § DIAMOND.	C. I. p. 188.	10·0.	3·4···3·6.

Lustre.	Color.	Streak.	Various Observations.
Vit. to res.	Dark greenish-black.	Greenish-grey.	Comp. impal. Frac. conchoidal.
Vit. to res.	Various shades of brown, green, & red.	White.	Comp. gran. and impal.
Vitreous.	White, blue, red, brown & green.	White.	Comp. col., gran. and impalpable.
Vit. to ad.	White, grey, yellow, and green.	White.	Comp. fine gran. and strongly connected: generally exhibits dichroism.
Vitreous.	Shades of blue & black.	White.	
Vit. to res.	Brown, blue, green, red, yellow and black.	White.	Composition columnar.
Vit. to res.	Reddish-brown.	White.	
Adamantine.	White, smalt-blue, pearl-grey and rose-red.		
Adamantine.	Red, brown, yellow, grey and white.	White.	
Vitreous.	Mountain-green, or pale blue.	White.	
Vitreous.	Flesh-red and pearl-grey.	White.	Comp. col. and gran.
Vitreous.	Yellowish-brown.	Paler than the color.	
Vitreous.	Green, blue, yellow and white.	White.	Comp. large granular.
Vit. to ad.	Hair-brown to greyish-white.	White.	Composition columnar: in thin fibres.
Vitreous.	Greyish-white.	White.	Comp, col. in thin fibres, curved & strongly connected.
Vitreous.	White, yellow, green and bluish.	White.	Comp. columnar, and easily overcome.
Vitreous.	Red, blue, green, and black.	White.	
Vit. to res.	Dirty-green, black and blue.	White.	Composition granular, easily overcome.
Vitreous.	Olive-green and yellowish-white.	White.	
Vitreous.	Blue, red, brown, grey and white.	White.	Composition granular, often impalpable.

Names.	Hardness	Sp. Grav.
APPENDIX. *(Consisting of species whose hardness has not been ascertained.)*		
A. ‖§ BUCKLANDITE. C. I. p. 182.		
B. ‖§ CAPILLARY PYRITES. C. I. p. 198.		

II. ORDER.

Names.	Sp. Grav.
1. ¶ BITUMEN. C. III. Ord. I. p. 212.	
Mineral-oil. Naphtha.	0·7...0·83.
2. ¶ WATER.	
Atmospheric Water. M.	1·0.
3. ¶ SULPHURIC ACID.	
Sulphuric Acid. M.	1·1...1·8.
4. NATIVE MERCURY.	
Native Mercury. M.	13·581.

III. ORDER.

Names.	Sp. Grav.
1. ¶ HYDROGEN.	
Pure Hydrogen-gas. M.	0·069.
2. ¶ CARBURETTED HYDROGEN.	
Empyreumatic Hydrogen-gas. M.	0·555.
3. ¶ NITROGEN.	
Azote.	0·969.
4. ¶ ATMOSPHERIC AIR.	
Atmospheric air. M.	1·000.
5. ¶ OXYGEN.	1·111.
6. ¶ SULPHURETTED HYDROGEN.	
Sulphuretted Hydrogen-gas. M.	1·1805.

Lustre.	Color.		Various Observations.
Metallic.	Dark-brown, nearly black. Brass-yellow to bronze-yellow & steel-grey.		Opake. (It resembles Augite.) In delicate, capillary crystals.

LIQUIDS.

Color.	Taste.	Various observations.
Yellowish or reddish brown to black.		Odor. peculiar. Transparent to opake.
Colorless.	Tasteless.	
Colorless.	Intensely acid.	
Tin white.	Tasteless.	Lustre metallic.

GASES.

Odor.	Taste.	Various observations.
Peculiar.	Tasteless.	
Empyreumatic.	Tasteless.	
Odorless.	Tasteless.	
Odorless.	Tasteless.	Respirable.
Odorless.	Tasteless.	Respirable.
Strongly fetid, like rotten eggs.		

Names.	Sp. Grav.	Odor.	Taste.
7. MURIATIC ACID. *Gaseous Muriatic-acid.* M. Hydro-chloric acid.	1·284.	Peculiar.	Intensely acid.
8. ¶ CARBONIC ACID. *Gaseous Carbonic-acid.* M.	1·527.	Pungent.	Weakly acid.
9. ¶ PHOSPHURETTED HYDROGEN. *Phosphuretted Hydrogen-gas.* M.	1·7708.	Garlic-like.	Bitter.
10. SULPHUREOUS ACID. *Gaseous Sulphuric-acid.* M.	2·22.	Like burning sulphur.	Intensely acid.

ALPHABETICAL LIST OF PROPOSED SPECIES WHICH ARE NOT YET FULLY ESTABLISHED.*

A.

Aeschyrite. Sp. Gr. above 4.? Color blackish.

Arsenical Antimony Glance. H. 2·0...3·0. Sp. Gr. 6·2. L. pale vit. C. tin-white.

Arsenical Bismuth, *Werner*. Soft. Heavy. C. dark hair-brown. L. res.

Arsenic Glance, *Breit*. H. 2·0. Sp. Gr. 5·2...5·5. C. lead-grey. Compact.

B.

Bismuth Blende, *Breit*.

Bismuth Cobalt-Ore. H. 4·0...5·0? Sp. Gr. 4·5...4·7. L. met. C. lead or steel-grey.

Bismuthic Silver. Soft. Sectile. L. met. C. light lead-grey. In acicular crystals, massive and compact.

Breisklakite, *Monticelli*. In delicate, reddish brown, capillary crystals.

Bustamite, *Brongniart*. H. 6·0...6·5. Sp. Gr. 3·1...3·3. C. light-grey, greenish or reddish. In reniform masses.

C.

Calcareous Heavy Spar, *Breit*. Sp. Gr. 4·0...4·2. Effloresces.

Carbonate of Bismuth. Sp. Gr. 4·3. C. grey and brown. Earthy.

Chalkosiderite, *Ullmann*.

Chamoisite, *Berthier*. Sp. Gr. 3·4. C. dark greenish-grey. Earthy. An impure Magnetic Iron-ore?

Chlorophæite, *Mc Culloch*. H. 1·5. Sp. Gr. 2·02. C. dark-green. Dull. In small imbedded globules.

Cobalt Vitriol, *Kopp*. L. vit. to pearly. C. flesh or rose-red. Trans. Taste astringent.

---

* Abbreviations.

Berzel. for Berzelius.	C. for color.	L. for lustre.
Breit. " Breithaupht.	H. " hardness.	Strom. " Stromeyer.

CONDURRITE, *Phillips*. H. 5·0? Brittle. C. brownish-black. Streak dark lead-grey; powder-black. Comp. impalpable.

COTTUNITE (CHLORIDE OF LEAD). *Monticelli and Covelli.*

CUPREOUS BISMUTH. Soft. Sectile. L. met. C. pale lead-grey to tin-white. Comp. col. and impal.

CUPREOUS MANGANESE. Sp. Gr. 3·1...3·2. L. res. C. bluish-black. Composition impalpable.

D.

DYSODILE, *Cordier*. Soft: scratched by the nail. Sp. Gr. 1·1...1·2. C. greenish and yellowish to liver-brown. Frac. earthy. Streak vit.

E.

EARTHY COBALT. Soft. Earthy. Sp. Gr. 2·2. C bluish and brownish-black. Streak shining. Bot. and stalac. shapes.

EDINGTONITE, *Haidinger*. H. 4·5. Sp. Gr. 2·7. L. vit. C. greenish-white. In small crystals.

ERLAN, *Breit*. H. 5·5...6·5. Sp. Gr. 3·0...3·1. L. feebly vit. C. greenish-grey. Streak white.

F.

FERRUGINOUS PLATINA, *Schwetzau*. Sp. Gr. 14·6...15·7. Less malleable than Native Platina. Magnetic.

FLUELLITE, *Wollaston*. C. white. Transparent. In minute crystals. Probably Wavellite.

FLUOLITE, *Breit*.

FLUATE OF CERIUM, *Berzel*. Sp. Gr. 4·1...4·7. C. reddish. In plates and masses.

G.

GALACTITE.

GIESECKITE, *Sowerby*. H. 2·5...3·0. Sp. Gr. 2·83. L. faint res. C. olive-green, grey and brown.

GLAUCOLITE. H. 5·5. Sp. Gr. 2·72. L. vit. C. blue to green.

GMELINITE, *Brewster*. Crystals small rhomboids. H. 4·5. Sp. Gr. 2·05. L. vit. C. white to red.

GREEN IRON-ORE.

H.

HALLOYITE, *Berthier*. H. 1·5...2·0. L. waxy. C. white, or slightly blue. Adheres to the tongue.

HARD COBALT PYRITES, *Breit.* H. 5·0...6·0. Sp. Gr. 6·7...6·8. L. met. C. dark tin-white. Massive.

HATCHETINE, *Conybeare.* Very soft. Very light. L. glistening and pearly. C. yellow. In flakes.

HERRENITE, *Del Rio.* (Carbonate of Tellurium and Bi-carbonate of Nickel.)

HISINGERITE, *Berzel.* Sectile. Soft. Sp. Gr. 3·04. C. black. Streak, greenish, grey. Fracture earthy.

HYDRO-CARBON, *Scherer.* Sp. Gr. 0·65. L. nacreous. White, or yellowish-white. Crystals acicular.

HYDROPHYLLITE, *Hausmann.*

HYDROSILICITE, *Kuh.* C. white, without lustre; feels greasy, is soft and translucent: does not adhere to the tongue.

I.

IODIDE OF MERCURY, *Del Rio.* Resembles dark colored Cinnabar.

IODIDE OF SILVER, *Vauquelin.*

IRID-OSMIUM, *Schwetzau.* In low six-sided prisms. H. 5·0...6·0. Sp. Gr. 17·9...18·5. C. lead-grey.

IRON-SINTER. Sp. Gr. 2·4. L. res. C. yellowish and blackish-brown. Brittle. Fracture conchoidal.

K.

KNEBILITE, *Lenz.* Hard. Sp. Gr. 3·7. L. glistening. C. grey, red, brown and green. Opake. Fracture imperfectly conchoidal.

KORNITE, *Breit.*

KUPFERINDIG, *Breit.* Soft. Sp. Gr. 3·8. L. faint res. C. blue. In plates forming spheroidal shapes, and impalpable.

L.

LEELITE, *Clark.* Sp. Gr. 2·7. Lustre and translucency like horn. Massive. Fracture splintery.

LIGURITE, *Viviani.* Crystallized. H. above 5·0. Sp. Gr. 3·49. L. between vit. and res. C. apple-green. Frac. uneven.

M.

MELLILITE. In crystalline grains. H. 6·0...6·5. C. yellowish or reddish-brown.

MINERAL HYDRO-CARBON, In acicular crystals. Sp. Gr. 0·65? L. nacreous. C. yellowish-white.

MOLYBDATE OF SILVER. (Silfer-phyllinglans,) *Breit.* Sp. Gr. 5·89. L. met. In flexible, bladed masses of a dark lead-grey color.

MONAZITE, *Breit.* Sp. Gr. 4·92. L. vit. C. brick-red. Streak flesh-red.

MONOPHANE, *Breit.* Sp. Gr. 2·15. H. below Feldspar. L. vit. C. white.

N.

NATIVE IRIDIUM.

NATIVE PALLADIUM.

NICKEL GLANCE, *Pfaff.* H. 5·5. Sp. Gr. 6·09. C. like Arsenical Pyrites. Cleavage parallel to the faces of the cube.

NONTRONITE, *Berthier.* Soft; opake: unctuous and tender. C. pale straw-color. In onion-shaped masses: compact.

O.

OKENITE, *Kobel.* H. 4·5...6·0. ? In almond-shaped masses; allied to the Zeolites.

OLIGOKLASE, *Breit.*

P.

PECTOLITE, *Kobel.* H. 4·5...6·0 ? Sp. Gr. 2·69. In spheroidal masses, consisting of delicate diverging individuals.

PETROSILEX (of Sahlberg.) C. deep flesh-red. Trans. Compact. Frac. fine grained.

PHASTINE, *Breit.*

PICOTITE, *Charpentier.*

PINGUITE, *Breit.* H. 1·0. Sp. Gr. 2·31. Resembles green Iron-earth.

PLOMB-GOMME, *Gillet-Laumont.* H. 5·0 ? C. yellowish and reddish-brown. Reniform. Composition thin columnar.

PRISMATIC MELANE-GLANCE. Sp. Gr. 6·2...6·3.

PRISMATOIDAL BISMUTH-GLANCE, *Wehrle.* H. 2·4. Sp. Gr. 7·8. Crystals prismatic.

PYROPHYLLITE, *Hermann.*

PYRORTHITE, *Berzel.* Soft. Sp. Gr. 2·19. L. res. C. brownish-black. Opake. Massive.

R.

RADIOLITE, *Brevig.* H. above 4·0. Sp. Gr. 2·2. C. white. L. silky. Massive, with a radiating fracture.

REUSSIN, *Kirwan.*

RUBELLAN, *Breit.* H. 3. L. vit. to res. C. brownish-red. Brittle.

S.

SAPPARITE, *Schlotheim.* H. above 4·0. L. vit. C. pale berlin-blue. Streak greyish-white.

SAPHIRIN, *Strom.* H. above 7·0. Sp. Gr. 3·4. L. vit. C. sapphire-blue. Streak white. Trans.

SCHEERERITE, *Strom.* Rather heavier than water. Very friable. C. whitish. L. pearly. In loosely aggregated grains and folia.

SELENIURET OF LEAD AND COBALT, *Rose.* Resembles Galena. Frac. granular.

SELENIURET OF LEAD AND COPPER, *Rose.* C. lead-grey. Frac. granular.

SELENIURET OF LEAD AND MERCURY, *Rose.* Sp. Gr. 7·8.

SELENIURET OF SILVER, *Berzel.*

Cuivre sélénié argental, *Haüy.*

Eukairite, *Berzel.*

C. lead-grey. In small six sided tables with truncated angles.

SELENIURET OF SULPHUR, *Strom.*

SILICATE OF IRON, (Bodenmais.)

SKORIAN, *Breit.*

SORDAWALLITE, *Nordenskiöld.* H. 5·0...6·0? Sp. Gr. 2·53. L. vit. C. greenish or greyish-black. Massive. Frac. conchoid.

STROMNITE, *Traill.* Sp. Gr. 3·7. C. yellowish-white. L. feeble, but pearly.

SULPHURET OF SILVER AND COPPER, *Phillips.* Soft. Sp. Gr. 6·25. L. met. C. blackish lead-grey. Massive. Comp. impal.

T.

TELLURIC BISMUTH, *Berzel.* L. met. C. silver-white. Massive, broad foliated.

TEPHROITE, *Breit.* H. 5·0...6·0. Sp. Gr. 4·1. L. adaman. C. ash-grey.

TESSERALKIES, *Breit.*

TUNGSTATE OF LEAD, *Phillips.* L. res. C. yellowish-grey. Crystals acute four sided pyramids, aggregated in bunches.

U.

URANIUM VITRIOL, *Johns.* L. vit. C. emerald and apple-green. In capillary crystals.

V.

VAUQUELINITE, *Leonhard.* H. 2·5...3·0. Sp. Gr. 5·5...5·78. L. adaman. C. some dark green. In minute crystals, and massive.

VELVET BLUE COPPER. L. pearly. C. bright smalt-blue. In short capillary crystals.

VIGNITE.
(Blue Magnetic Iron-ore.) Sp. Gr. 3·71. C. dark greenish-blue.

W.

WHITE IRON-SINTER.

WILLEMITE, *Levy*. C. white, yellowish, or reddish. Trans. In small rhomboidal crystals.

Y.

YTTRO-CERITE, *Berzel*. H. between 4·0 and 5·0? Sp. Gr. 3·44. C. violet-blue. Massive. Opake.

YTTRO-TANTALITE. H. 5·5? Sp. Gr. 5·3...5·8. L. imperfect met. C. blackish-brown, or black. Opake. Massive.

Z.

ZURLITE, *Ramondini*. H. 6·0. Sp. Gr. 3·27. L. res. C. green to grey. In rectangular four sided tables.

PART. V.

PHYSIOGRAPHY.

§. 123. Definition.

Physiography is the description of natural productions, and consists in the enumeration of all their natural properties. It is intended to produce a distinct image of those objects which we distinguish from each other by means of the Characteristic, and denominate conformably to the rules laid down in the Nomenclature.

Physiography is not adapted to the purpose of distinguishing minerals. We cannot therefore, by its assistance, find the place of a given mineral in the system, or in other words, recognise it; for it is independent of that connexion among natural productions upon which systems are founded, and considers them singly, every one by itself. Physiography, therefore, cannot acquiesce in considering single characters or characteristic marks; but it must exhibit them all, if the image it produces is meant to be a complete and satisfactory one. Its difference from the Characteristic founded upon these properties, is as obvious as the impossibility of substituting the one instead of the other. A description, therefore, is not a character; since the peculiarity of every character consists in its being composed of a smaller number of characteristic terms that may be observed in the objects characterized.

The descriptions presuppose nothing but Terminology. It is perfectly indifferent what nomenclature is adopted in Physiography, provided only the names and denominations to which the descriptions of the species refer, answer the purpose of keeping separate those objects, which really differ from each other.

The system of Prof. Mohs, is the only one which has hitherto presented a separate view of the Determinative and the Descriptive parts of Mineralogy. The greater part of the mineralogical works have given to the characters such an arrangement, that they may at the same time represent the general descriptions of the spe-

cies, and to the general arrangement of the species, such an arrangement that they may in like manner, serve the purpose of characters. Neither of these plans entirely answers the purpose; and those who wish to become acquainted with minerals, or to acquire some knowledge of their natural properties, are still under the necessity of proceeding upon the old empirical method. They must content themselves with a superficial and broken sort of knowledge, to which they themselves do not attach any security; whereas the systematic way of proceeding leads to information, that is solid, connected, and as complete as possible.

§. 124. Object of Physiography.

The object to which Physiography refers, in the mineral kingdom, in as far as it produces a MERE description, is the Individual.

Any description, containing the indication of all the properties, will suffice for determining a particular individual. In the animal and vegetable kingdoms, homogeneous individuals are in most cases at the same time identical, excepting their sexual differences; or at least the deviations occurring in their single characters may be considered as merely accidental. One individual, therefore, or in the case of an existing difference in the sexes, two of them, will represent the whole species. In the mineral kingdom, the homogeneous individuals in most cases differ so widely from each other, that a description of the one does not by any means apply to another; one, or a few of them, therefore, cannot represent the whole species, nor can their description be substituted instead of the description of the species. The description of all the varieties of a species does not produce a clear idea of the species itself; because the species is not a *single* body, but the assemblage of all the homogeneous individuals or varieties. Individuals, only, therefore, (or compositions of individuals) admit of being described; and this is effected by indicating all their natural properties. In enumerating these, it is important to adopt some order of succession, which, for the sake of the greater perspicuity, should remain unaltered. All prolixity should be carefully avoided: every superfluous word, every ambiguous expression, in short, every thing foreign to the purpose should be rejected; and such terms employed as are explained in the Terminology. Abbreviations of frequently occurring

words and expressions should uniformly be adopted, when not inconsistent with an easy comprehension of their meaning.

Descriptions are required, whenever there occur new varieties of a species which is either already known, or entirely new; they are also useful in such varieties as are distinguished by a particular application, or any remarkable property, or such as have been provided with particular names in the arts of life. In these last instances it is only requisite to indicate those properties, by which the variety in question differs from other varieties of the same species. It is also very useful to give an accurate description of such varieties as are subjected to a chemical analysis.

§. 125. General Description of the Species.

In representing the species in the mineral kingdom, it is necessary to construct a Collective, or General Description.

The problem to be resolved in constructing a General Description is, to give a correct idea of all, or at least of the known varieties of a species, in their proper connexion; it must therefore contain at once all the descriptions of these varieties without its being itself, in a strict sense, a description at all. It is evident, that the only means of arriving at this end, will be the employment of the series of characters.

The method of constructing a general description of a species is as follows. First, any suitable variety of the species is chosen, and described with all possible accuracy,—the single characters succeeding each other agreeably to the order fixed upon, as abovementioned. The description will contain only single characters, consisting of a certain form, a certain color, a certain kind of lustre, a certain degree of hardness or of specific gravity, &c., all of these being members of their respective series. If, in the place of every one of these single characters, we substitute the complete series to which it belongs, the *Description of the Individual*, or of the variety, is transformed into the *Collective* or *General Description of the Species*

The characters contained in the general description are expressed in series, produced either by immediate observation, or by derivation. The characters in the descriptions of determined varieties consist of single members of these series. Evidently, the collective description not only produces a complete idea of the spe-

cies itself, but it also contains the individual description of every one of its single varieties; for as to the latter, if we choose arbitrarily any single member from every one of the mentioned series, and join these members in the adopted order of succession, the result will be the description of a variety, belonging to the species.

The representation of the species as contained in the general description, is far more complete, than it could be obtained by immediate observation; for it unites all the varieties which may be produced by all possible combinations of the single properties, (the members of different series.) It would contain all the varieties possible in a species if the series themselves were complete, which can be maintained only of those produced by derivation from given forms. Thus the considerations referring to the mineral kingdom become both fertile and interesting; because, by means of the general description, we obtain from every newly discovered variety, though it should differ from those already known, only in a single character, an almost endless number of new varieties, which may be produced by uniting the newly discovered property with every combination of the members of the other series which the general description contains.

The pure, or properly so called, general description, refers only to the individuals of the species, because it is from these that we derive the most perfect of the characteristic marks employed in mineralogy. If the compound varieties are to be noticed, this must be done without mixing them up with the simple ones.

From the preceding remarks, it appears that the general description presupposes the correct idea of the species.

§. 126. Arrangement of the General Description.

The general or collective descriptions require to be so arranged, as to facilitate their use as much as possible, and to produce, in fact, a complete general view of the species.

In order to determine the series of crystallization of a species, it becomes necessary to indicate the primary form, with its dimensions, except in those cases where these are always the same as in the regular Octahedron, Cube, &c. Accordingly, in the second part of this treatise, this will first be given, along with the information whether it be deduced from calculation, observed in the crystals themselves, or obtained from cleavage. In forms of variable dimensions, notice is also appended whether the value of their angles was

obtained by means of the Reflective Goniometer, or by the Common Goniometer.

The primary form being known, the series of forms to which it is capable of giving rise, may, in general, be easily inferred from the known laws of derivation (§. 51). Still, it is necessary for us to present in the general description, as far as possible, the forms that actually do occur: since this information is peculiarly important and interesting, and without it, the picture of the species would indeed be deficient. Commencing, therefore, with the primary form, provided it exists unmodified among the crystals of the species, we proceed to enumerate the most frequent of the occurring forms. Next to the primary, (or in the absence of this, the one most closely allied to it,) we mention that modification which may be considered next in remove from it, and so on in a series, terminating with the most complicated and irregular forms; illustrating such of them as are conceived of with difficulty from mere description by diagrams, and occasionally adding the mutual inclinations of particular faces. To this enumeration will also be annexed, in many instances, remarks to point out the localities of particular forms, as well as their comparative rarity or abundance.

The phenomenon of cleavage being in the nearest relation to the crystalline forms, the next place in the collective description will be assigned to it. The forms of cleavage, so far as obtainable, are described; and particular notice bestowed upon the degree of perfection in the different faces of cleavage.

Fracture, so far as it is contained in the collective description itself, refers only to simple minerals. It cannot be deemed however, very important. Several varieties of fracture, if mentioned in one and the same place, denote the limits between which the varieties range, which occur in the species. Also, it is indicated whether the fracture be obtained easily, or with difficulty.

The physical quality of the surface of the crystals is far more important than fracture, since it is in close connexion with the crystalline forms themselves. These faces are expressed by the letters appropriated to the faces of the different forms.

The characters depending upon the presence of light, contribute very much to enliven the image or representation of the species. The kinds of lustre must every where be mentioned; and if there should be found a difference as to its occurrence upon different faces, in which different kinds of lustre may be observed, this must be pointed out.

In order to express the series of colors, more room is required in the general description than can well be allowed, since to do this fully requires that all the single members be mentioned. As a substitute, however, an outline of these series is given, by indicating their principal points. This mode of treating the subject does by no means injure the use of the series of colors, nor diminish their importance in enlivening the collective descriptions. Colors produced by occasional admixtures of minerals foreign to the species, do not properly belong to the collective description; because they are not members of the series of colors of the species described. Yet they are indicated by themselves, at least the common shades, in order to exclude them from those with which they are not connected by transitions within the same series.

The color of the powder, or streak, is next indicated. To which follow the limits for the degrees of transparency, and notice of action on light, (or refraction.)

Lastly the general descriptions contain the indication of the form of aggregation, of hardness, specific gravity, and other characteristic marks, derived from, or respecting, the substance of minerals, as odor, taste, &c., which may be useful in the description of varieties; all of them expressed with the utmost degree of brevity, possible.

A great number of the different varieties of certain species is produced by the composition of their individuals. The collective description of the simple varieties, having already been drawn up with considerable minuteness, it will now be the easier to survey the compound varieties. The general consideration of the twin crystals (§. 72 & 73), contains the principles of the method, according to which, those belonging to any particular species, may be indicated with precision and convenience. These compositions will also be illustrated, where necessary, by diagrams.

It will be sufficient only to mention the imitative forms, in order to recal their properties to the memory, these being commonly so much alike in every instance, that they allow of a general explanation, which has been given in its proper place. The condition of their surface, or of the faces of composition in their interior, the shape of the particles of composition, and the mode of that composition itself, may likewise be indicated. The same applies also to amorphous compositions, or, as they are called, to the *massive* varieties. As to these, the most important properties to be mentioned will be, the shape of the component particles, their size, mode of aggregation, and fracture. Thus we are capable of expressing in a few words,

much that has been described with great prolixity; while we enjoy the advantage of arriving at an idea of the subject, correct and general, and conformable to nature.

The pseudomorphoses need nothing more than to be mentioned. If other properties should happen to occur beside those above alluded to, they will be inserted in a proper order, provided they contribute to our knowledge of the natural properties of the species to which they belong; whereas, if any of the foregoing are wanting they will be passed over in silence. In general, some one or other of the natural properties may be rendered more prominent, the more it contributes to a clear and distinct image of the species.

The collective descriptions of the species form one of the most important subjects of the Natural History of the mineral kingdom. Although they represent the mineral species by themselves, not regarding their resemblance to others, yet they effect this in the minutest detail, and to the greatest possible completeness, and hence they contain all the natural historical information, properly so called, relative to mineral productions.

§. 127. Collective Descriptions independent of all systems.

The collective descriptions do not depend upon the systems; but are applicable in every system.

The collective description represents the natural historical species developed in the minutest detail. This species is the basis of every method, or in fact of every science, which refers to the productions of the mineral kingdom: it is the object, not the product of classification. It may be applied in a natural or artificial system, whether drawn up in conformity with the principles of Natural History, or to those of any science: nor is it less applicable in an alphabetical arrangement, since descriptions are consulted very much after the manner of a dictionary of words.

§. 128. Additional Information appended to the Collective Descriptions in the Second Part of this Treatise.

The general descriptions limited as above (§. 126), necessarily exclude a variety of important information (most-

ly, indeed, foreign to Mineralogy); this is arranged in a systematic order, and forms an appendage to the collective description of each species.

The rules adopted in forming the general description, required the omission of several facts relating to crystallography, the history of the species as connected with its division into sub-species and varieties by other writers, &c., information, nevertheless, which is requisite to be understood: this will be collected together and placed immediately after the general descriptions in a smaller type.

The collective descriptions being thus rendered as complete as possible, mineralogy, as a pure science, may be said to have discharged its duty; and its species are now fit to be subjected to investigation in other sciences, each of which will produce a mass of information concerning them, according to its peculiar nature. This information the student in mineralogy will desire to become acquainted with. He will seek, for example, to know the chemical properties of the mineral, whose name and natural properties he has just ascertained; its geological position likewise, and its application to useful purposes. To save him the inconvenience of consulting other works in which this various knowledge is contained, the results of the different sciences to which it belongs, are introduced into the present treatise, and form the conclusion of the appendage to the general descriptions.

These results will be introduced in the following order: 1. Those derived from Chemistry, as the properties of the species before the blowpipe, or when acted upon by acids, one or more analyses by the most celebrated chemists, to which will be added such facts as are known concerning the artificial production of the species, by mingling the ingredients in the proper proportions in our Laboratories: 2. Geological information, or facts relating to the mode in which the species occurs in nature, as the particular rock in which it is engaged, the manner of its engagement, whether in veins, beds or disseminated, &c.: 3. The Geographical distribution, which is much less important than that of plants or animals, in which so much depends upon climate, soil and other accidental circumstances; American localities, however, are carefully designated: 4. Application and uses of the species in the arts. To which is sometimes added another head for the purpose of introducing miscellaneous observations, which do not, strictly speaking, fall under any of the above provisions.

END OF PART FIRST.

TREATISE

ON

MINERALOGY:

SECOND PART,

CONSISTING OF

DESCRIPTIONS OF THE SPECIES, AND TABLES ILLUSTRATIVE OF THEIR NATURAL AND CHEMICAL AFFINITIES.

WITH FIVE HUNDRED WOOD CUTS.

BY

CHARLES UPHAM SHEPARD, A. B.

Lecturer on Natural History in Yale College; Member of the American Geological Society; Corresponding Member of the Academy of Natural Sciences of Philadelphia; of the Natural History Society of Montreal, and of the Geological Society of France, &c.

IN TWO VOLUMES.

VOLUME 1.

NEW HAVEN:

HEZEKIAH HOWE & CO.

AND

HERRICK & NOYES.

1835.

Entered according to an Act of Congress, in the year 1835,
by CHARLES UPHAM SHEPARD,
in the Clerk's office, of the District Court of Connecticut.

Printed by Hezekiah Howe & Co.

TO

BENJAMIN SILLIMAN, LL. D.

PROFESSOR OF CHEMISTRY, MINERALOGY AND GEOLOGY

IN YALE COLLEGE,

&c. &c.

Dear Sir,

The distinguished services you have rendered to the cause of Mineralogy and Geology in America, not merely in contributing to their early introduction, but to their efficient cultivation among us, prompt me to dedicate the present work to you.

The wisdom and zeal of those exertions which secured to Yale College the most splendid collection of minerals in the country, the valuable instruction and enthusiasm imparted by your lectures to a great body of young men now dispersed through the whole nation, and the public spirit which has led you at a personal sacrifice to maintain in the American Journal of Science a free medium for the diffusion of this kind of knowledge, are too well known and justly appreciated to require the feeble acknowledgment

of this tribute; but as the work was undertaken at your suggestion, and has been aided in its progress by your advice, I may perhaps be permitted the pleasure of improving this occasion to express publicly the sense I feel of the value of your labors, and to acknowledge the many kind services for which I stand indebted to your friendship.

I have the honor to be,

Your very faithful

And obliged Servant,

CHARLES U. SHEPARD.

New Haven, May, 1835.

PREFACE.

The eclectic character of my introductory volume, which was intended to give a view of all the departments of Mineralogy excepting Physiography, rendered it difficult for persons employing it to avail themselves of other treatises for full descriptions of the species. The inapplicability was principally owing to my adoption of the improvements of Mohs in relation to simple and compound varieties and to the numerical scale for expressing the hardness, and to my following Brooke in the treatment of the regular forms; not to mention the circumstance, that my artificial tables enumerated a number of species whose descriptions had not found their way into any English work. This was foreseen in the preparation of that volume; and notice was accordingly given in it, that a second part, devoted exclusively to descriptions, and constructed in accordance with the principles of the first, was in preparation.

In addition to the desire of supplying what was thus wanting to carry out the plan of study which had appeared to me to possess the greatest advantages, I was stimulated to the attempt, in the hope of being able to contribute something towards the more satisfactory determination of American localities; an undertaking for which my mineralogical travels had afforded me considerable facilities. Indeed, so numerous had been the discoveries in important mineral depositories since the last edition of Cleaveland's

Mineralogy and the publication of ROBINSON's Catalogue, and so many doubtful points existed in relation to many of those quoted in these works—not a few having been erroneously announced, either through inaccurate determinations of the species, or their occurrence in trifling and accidental quantitity—that the proposed work seemed justifiable solely on this ground, provided there was a reasonable hope of placing the subject in a more just light. Besides, it was had in view to indicate the crystalline forms noticeable among our minerals, a point which had been so much overlooked as to have created a very unfavorable impression of the mineralogical riches of the country. There seemed room also, to perform a desirable service by appropriating to the work the latest discoveries of the German mineralogists, to whom the science is indebted for its most important advances during the last ten years.

The general rules according to which the descriptions have been drawn up, are those laid down in §. 126, of the Introductory volume. The trivial names to the species having been adopted in the analytical tables for the reasons given in §. 117, it became necessary to employ them also in the present work. Indeed so small is the number of species in the mineral kingdom compared with the species in the other departments of Natural History, and so deficient in fixity are many of the still accounted species, that it is, and probably for some time to come will be, most prudent to call them by these names. The chemical designations having by general usage been dropped where other names existed, BEUDANT in his system of Mineralogy has attempted by the invention of new names, where it was necessary, to render universal the application of the

trivial nomenclature. Approving of this reform, I have adopted his names in numerous instances; and where species were still left unprovided with trivial epithets, I have ventured in a few instances to propose them.

To the trivial name, the systematic denomination is added in a smaller type, as it appeared to me important not to lose sight of what in its other branches, is conceded to be one of the greatest advantages of Natural History; viz. that of expressing in the names, the connexion in natural properties, subsisting among the species. Whether the names here employed, which are mostly those contrived by Mohs, will ultimately be approved of by Naturalists, is not at present certain; but their use in the intercourse of Mineralogists will often be found to possess important convenience, and though compelled in the future and more perfected state of the science to give place to simpler expressions—perhaps to those, constructed according to the genius of the Latin language by which means the difficulty of their translation from one language into another will be avoided—they still appeared to me to be worthy of being retained, especially as they are introduced merely as synonyms.

The alphabetical arrangement of the species has been adopted because it seemed most likely to subserve the convenience of students using my characteristic, or any other, in the determination of specimens; as well as that of persons having occasion to refer to the descriptions for less general purposes, as for example, to learn only the crystalline form of a particular species, or to obtain information respecting its locality. Had the natural-historical arrangement, the chemical, or any mixture of the two, been em-

ployed, the inconvenience of consulting an index must necessarily have been encountered.

But while the alphabetical distribution has the advantage at least, of being independent of all scientific arrangement—concerning whose present existence many entertain doubts,—the two tabular views, one at the commencement of this volume, and the other at the conclusion of the second, will present the species grouped in accordance with two classes of affinities, the first, the natural-historical, the second, the chemical, resemblance. In the construction of these tables, I cannot, of course, suppose that I have acquitted myself to the satisfaction of all, when I have but so imperfectly satisfied myself.

The chemical arrangement, however, is such as the present state of chemical science seemed to force upon me without much choice. A more extensive and accurate analysis of minerals, however, will undoubtedly produce in it many changes, while also it will permit the composition of a considerable number of species, now left in uncertainty, to be expressed with atomic precision.

Both in this tabular view, and elsewhere in the work, I have refrained from adopting the algebraical language of Berzelius for denoting the chemical constitution of minerals, although it would have afforded much convenience in the present state of chemical nomenclature, more particularly in relation to isomorphous compounds, because I have every where sought to exclude whatever has an abstruse and forbidding air; knowing that many have been discouraged from entering upon this pleasing and fa-

cile pursuit by the discovery of even the occasional use of unintelligible language in a professedly elementary treatise of its principles.

The natural-historical arrangement of the species is principally that brought forward by Mohs. I have nevertheless ventured, though not without considerable hesitation, to propose a number of alterations, which will be obvious on a comparison of the two systems. In making these changes, I have endeavored so to constitute the genera that the species of each should be bound together by a similar amount of resemblance. If in the execution of this difficult task, I have not violated the affinities of the species, an important advantage will have been secured in the simplification of the nomenclature by the great reduction of genera, especially in the orders, *Ore*, *Pyrites*, *Glance* and *Blende*.

The formation of the new order, *Picrosmine*, appeared to be indispensable in providing a place for a number of species, which Mohs had declined incorporating with his system from their deficiency in regular forms. The production of the genus *Lusine-Ore* was rendered necessary for a similar reason, in order to receive such species of the requisite structure and specific gravity, as are believed to owe their formation to the decomposition of other species. The above mentioned writer does not allow such minerals, provided they are in a friable state, to constitute distinct species; remarking of them, that "it is in direct opposition to the principles of Natural History, to consider decomposed varieties of one species as varieties of another." To the correctness of this as a general rule I readily assent, allowing it full force when the resulting mass is not homo-

geneous in its mechanical composition and at the same time destitute of a fixed chemical constitution.

The general order observed in the particulars of the descriptions is that adopted by Mohs, whose language in relation to a number of the properties has been employed, *verbatim*. The description of the regular forms, however, is quite different and requires some explanation. In many instances, all the observed forms are represented; in others, where the number was too great to admit of this, such a selection has been made as appeared best adapted to give a correct idea of the entire series of modifications within the species. The locality is sometimes subjoined, when the form represented is not common, or when it is known to occur at a particular spot in unusual perfection.

The primary forms of Brooke have been adhered to, more for the reason that they are still in such common use in English works and from their expressing in general the cleavage forms with correctness, than because they are in every instance the most simple solids from which the secondaries are capable of being derived. In the last mentioned view, they would certainly admit of a very important reduction. The tetrahedron, cube, regular octahedron and rhombic dodecahedron might form a single system,—the right square prism and the octahedron with a square base, another,—the right rectangular prism and the octahedron with a rectangular base, a third,—and the right rhombic prism and the octahedron with a rhombic base, a fourth system.

For the sake of easy intelligibility also, the angles and faces of the crystals are described without adopting an al-

gebraical system of notation. Nor have I thought it best to quote the corrected angles in place of such as were obtained by observation, except in those crystals depending upon forms of invariable dimensions. In other cases, it would no doubt have been safe to have employed such angles in the great majority of instances, yet the slight variations occurring in the constancy of angles in the individuals of several species, still leaves us in doubt what dimensions to assume as the most free from error by which to correct the others. Until this confusion is removed, the student will not suffer much inconvenience by adopting the present somewhat circuitous method of becoming acquainted with crystals. And besides, to have adopted the mathematical treatment of crystals alluded to, would have prevented a large number of persons from understanding the subject, to whom in its present popular form, it is perfectly intelligible.

In the preparation of this work it has been necessary to examine a great number of doubtful minerals, as well as newly proposed species with which the Scientific Journals abound. It may therefore be expected that something should be said in this place concerning the disposition which has been made of these materials. But a single new species, the *Microlite*, has been proposed; though a number of observations have been made, calculated to place the specific claims of a few minerals before proposed in a stronger light.

If, however, my investigations have not led me to increase the number of species, they have on the other hand, compelled me to treat a number heretofore regarded distinct, as varieties only of older species,—examples of

which are the *Fibrolite*, *Sillimanite*, *Pinite*, *Fowlerite*, *Deweylite*, *Marmolite*, &c.

But while I have constantly been concerned to find good reasons for reducing the number of the species, I cannot concur in the proposal of Rose for uniting *Pyroxene* and *Hornblende*, notwithstanding the ingenious reasons he uses in favor of this procedure. To overlook their marked disagreement in crystalline structure and to cause them to coalesce, would shake to the foundations the most secure support of all specific distinction. These species as they occur in the United States do not at all favor his conclusion, inasmuch as they exist together at several places in dolomite, preserving their peculiar angles and cleavages.

The proposed union of *Schiller Spar* with *Pyroxene* by Kobell, is equally in violation of two of the best specific properties in the absence of crystalline form; viz. specific gravity and hardness. Indeed, all conclusions in case of such complex compounds, drawn from chemical composition, must necessarily be indecisive.

The introduction of historical matter, as well as a notice of the authorities quoted, has been avoided, excepting only the mention of the author to the systematic name of the species, and occasionally the source whence the angles and the specific gravity have been derived.* To have carried these acknowledgments farther, would have swelled the dimensions of the work to an inconvenient size, without having proportionably enhanced its value as an elementary treatise. The more accomplished mineralogist will of

* The works to which I have been most indebted in the preparation of this Treatise, are mentioned at the conclusion of the preface.

course always have at hand the requisite works for consultation when information of this kind is desired. The best single work adapted to the purpose, with which I am acquainted, is the *Handbuch* of LEONHARD.

It will not be demanded of me to pronounce a panegyric upon Mineralogy. When systematically and thoroughly pursued, it does not yield in rational interest to any department of Natural History; but if its fundamental principles are overlooked, or but imperfectly acquired, the pursuit can afford no satisfaction to a sound mind. A degree of excitement may indeed attend the accumulation of rarities, but this is usually of temporary duration; and if a good cabinet should be acquired, the perpetual conviction of ignorance, which its inspection is calculated to force upon the possessor, is sufficient to produce ultimate indifference, if not disgust. When on the contrary, the preliminary principles are acquired, the progress of the pupil is uniform, rapid and delightful. Every acquisition to his collection supplies some link in the chain of his knowledge. His cabinet will exhibit the symmetry and beauty of his attainments. Every specimen worthy of possession, will have its location defined beforehand, from which it cannot be removed without a palpable violation of order. A cabinet thus formed becomes of itself an expression of the principles of the science, by means of which its possessor is enabled to corroborate the accuracy of its details, to correct its errors, and to extend its limits. Nature here becomes the guide and teacher, at the same time permitting the pupil to experience the enthusiasm, and to sustain the dignity, of an original investigator.

But though mineralogy thus pursued, fully rewards her devotees, its numerous connected inquiries and pursuits confer upon it, also, a high and deserving interest.

To the chemist who proposes to extend his knowledge to the productions of the mineral kingdom, this science becomes indispensable in order to enable him to know what he has analyzed, or how to distinguish and describe the body whose composition he has studied. To the geologist also, it is a collateral study of no small importance; since the discrimination of many rocks, and the description of all, depend upon a knowledge of no inconsiderable number of mineral species.

Of connected inquiries, however, the most fertile and highly interesting, is that arising out of the regular forms assumed by crystals, where, considering the absence of the living principle, a most surprising mixture of simplicity and complexness exists. To trace out the geometrical and numerical laws by which the secondary forms are derived from a few fundamental solids, though essential as a part of determinative and descriptive mineralogy, still leaves out of the question numerous, shorter and more beautiful modes of treating the subject, in consequence of the circuitous route by which it is necessarily effected in popular treatises. The invention, therefore, of new and more scientific methods of studying the geometry of crystals will always afford entertainment and delight to those who possess the adequate mathematical knowledge. The theoretical consideration of the shapes possessed by the elementary particles as connected with the same subject, though without any positive means of verification and utility in the practice of mineralogy, will afford to such inquirers a pleasing occupation.

As a collateral pursuit, that of Optics is perhaps one of the most beautiful and productive, as seems to be evinced by the rich harvest of discoveries made by BREWSTER in relation to the polarization of light and double refraction,—discoveries which are fruitful in new and highly curious experimental phenomena, as well as useful in affording an unexpected method for detecting in ambiguous cases, the primary forms of crystals. In addition to which mention may be made of HERSCHEL's ingenious explanation relative to the deviation of the succession of colors, which many crystals exhibit, from that scale of tints established by NEWTON, by conceiving the axis of double refraction to be different for different colors; and of another discovery of the same philosopher, concerning the circular polarization of light to the right or left, and the plagihedral crystallization of Quartz; (see figures 371 and 373,) from which it appears that right handed polarization always accompanies right handed plagihedral faces, and left handed polarization, left handed faces. Very interesting observations are likewise connected with the origin of the various kinds of lustre as dependent on structure, and the phenomena of colors in Labradorite as the result of internal cavities having the shape of the primary solid.

Not the least curious developement is that made by SAVART, from which it appears that the acoustical phenomena depending on the elasticity of the parts of the crystal lead to information connected with the internal structure of minerals. The elasticity of all the diametral lines in transverse plates cut from a common crystal of Quartz, parallel to the axis, having similar optical properties, is equal; but though all the plates cut parallel to the axis have similar optical relations, their acoustical properties have a relation to the

edges of the prism; such however, that any three plates at angles of 120° have an equal acoustical elasticity. He found also that by the acoustical properties he could determine the cleavage planes of Quartz, and in general whether a given portion of a mineral belongs to a simple crystal, or to a mass of compound individuals, as the vibration in the different cases gives corresponding differences of note, amounting to a full tone.

Besides its own peculiar attractions, and the recommendations it possesses from its affiliation with many branches of general Physics, there is necessarily superadded to mineralogy in this country a strong interest arising out of the unexplored state of its mineral riches. By far the largest part of our territory still waits for the first labors of the Mineralogist; and as proof that the full harvest of discovery has not yet been gathered in even in the New England states, New York, New Jersey and Pennsylvania, in which mineralogical inquiries commenced, and where they have been followed up with the greatest activity, it needs only to be mentioned that these states still continue to develope with each passing year, discoveries of increasing interest. Should the present work contribute to promote investigations so inviting in themselves, and so important to mankind, whereby the science may reap fresh acquisitions, and the country increased resources, I shall experience a reward greatly beyond the merits of such imperfect labors.

CHARLES U. SHEPARD.

New Haven, May, 1835.

LIST OF THE PRINCIPAL WORKS CONSULTED IN THE PREPARATION OF THIS TREATISE.

Treatise on Mineralogy, by Frederick Mohs, translated from the German, with considerable additions, by William Haidinger. Edinburgh, 1825.

Traité élémentaire de Minéralogie par F. S. Beudant. Paris, 1830.

Vollständige Charakteristik des Mineral-Systems, von August Breithaupt. Dresden and Leipzig, 1832.

Charakteristik der Mineralien, von Franz von Kobell. Nurenberg, 1831.

Traité de Minéralogie, par L'Abbe' Hauy. Paris, 1823.

Die Mineralogie in sechs und Zwanzig Vorlesungen, von Dr. Carl Friedr. Alex. Hartmann. Ilmenau, 1829.

Handbuch der Oryktognosie von Carl Caesar von Leonhard. Heidelberg, 1826.

Die Anwendung des Löthrohrs in der Chemie und Mineralogie, von T. Jacob Berzelius. Nürnberg, 1828.

An Elementary Introduction to the Knowledge of Mineralogy, by William Phillips. London, 1823.

An Elementary Treatise on Mineralogy and Geology, by Parker Cleaveland. Boston, 1822.

Nouveau Système de Minéralogie, par J. J. Berzelius. Paris, 1819.

Elementos de Orictognosia, por el C. Andres del Rio. Filadelfia, 1832.

Minéralogie appliquée aux Arts, par C. P. Brard. Paris, 1821.

Der Naturgeschichte des Mineralreiches, von Friederich Mohs. Wien, 1832.

A Manual of Mineralogy, by Robert Allan. Edinburg, 1834.

Numerous works devoted to Crystallography, among which may be mentioned those of Hauy, Bournon, Brochant, Brooke and Naumann.

Various Memoirs in the different English, French and German Journals, and Transactions of Academies and Learned Societies; the Yearly Account of the Progress of Chemistry and Mineralogy, by Berzelius; the American Journal of Science; the Transactions of the Academy of Natural Sciences of Philadelphia, and of the New York Lyceum.

BREITHAUPT'S SCALE OF HARDNESS.

1. Foliated Talc. 2. Foliated Gypsum. 3. Foliated Mica. 4. Calcareous Spar, distinctly foliated. 5. Fluor, distinctly foliated. 6. Apatite. 7. Sodalite, vitreous Actynolite and foliated Scapolite. 8. Adularia. 9. Quartz. 10. Topaz. 11. Foliated Corundum. 12. Diamond.

ERRATA.

VOL. I.

Page 12, line 31, *for* Yttria *read* Lithia. [and *dele* PARTSCH.
" 43, " 20, *for* Habroneme-Malachite *read* Copper-Baryte
" 51, " 7, *after* P *insert* on do.
" 83, " 21, *for* 93° 40′ *read* 136° 50′.
" 83, " 23, *for* 87° 8′ *read* 133° 34′.
" 101, " 2, *for* 135° *read* 127° 27′.
" 122, " 10, *for* 80° *read* 60°.
" 143, " 25, *for* 107° 05′ *read* 177° 05′.
" 147, " 25, *for* 49·00 *read* 58 71.
" 147, " 26, *for* 14·00 *read* 21·31.
" 147, " 27, *for* 35·00 *read* 19·98.
" 159, " 30, *for* Cupreous *read* Euotomous.
" 160, " 20, *for* Prismatoidal *read* Cupreous.
" 178, " 1, *for* Pyramidal *read* Prismatic.
" 188, " 10, *for* 54·44 *read* 59·44.
" 233, " 5, *for* 180° *read* 130°.
" 233, " 18, *for* Antimony *read* Tellurium.
" 256, " 10, *for* 115° 53′ *read* 64° 51′.
" 281, " 26, *for* Iron *read* Chlorone.

VOL. II.

Page 31, line 28, *for* protoxide *read* peroxide.
" 32, " 9, *insert* color black.
" 48, " 13, *for* Molybdic *read* Plombic.
" 128, " 24, *for* Brachytypous *read* Pyromorphous.
" 176, " 14, *for* SCHEEVERITE *read* SCHEENERITE.
" 186, " 28, *after* Rome *insert* and.
" 279, " 24, *for* WOLCHOUSKOIT *read* WOLCHONSKOIT.
" 288, " 19, *for* Prismatic *read* Hemi-Prismatic.
" 293, " 9, *for* rather *read* rarely.
" 296, " 16, *for* affixed *read* prefixed.

TABULAR VIEW

OF THE

CLASSES, ORDERS, GENERA AND SPECIES OF THE NATURAL SYSTEM.*

GENERAL PROPERTIES OF THE CLASSES.

CLASS I.

G. under 3·8.

No bituminous odor.

CLASS II.

G. above 1·8.

Tasteless.

---

* The following abbreviations are employed in the tabular view:

G. for Specific Gravity.
H. for Hardness.
Beu. for Beudant.
B. for Breithaupt.
H. for Haidinger.
M. for Mohs.
P. for Partsch.
S. for Shepard.

CLASS III.

G. under 1·8.

GENERAL PROPERTIES OF THE ORDERS OF CLASS I.

Order I. Gas. (M.)

G. 0·0001 ... 0·0014.
Gasiform.
Not acid.

Order II. Water. (M.)

G. 1·0.
Liquid.
Tasteless.

Order III. Acid. (M.)

G. 0·0015 ... 3·7.
Acid.

Order IV. Salt. (M.)

G. 1·2 ... 2·9.
Solid.
Not acid.

GENERAL PROPERTIES OF THE ORDERS OF CLASS II.

Order I. Haloide.[1] (M.)

Unmetallic. Streak uncolored.
H. 2·0 ... 5·0.
G. 2·2 ... 3·5.

---

[1] Αλς, *salt*, and ειχὸς, *like*.

Order II. Baryte.[2] (M.)

Unmetallic. Streak uncolored, or orange-yellow.
H. 2·5 ... 6·0.
G. 3·3 ... 7·3.

Order III. Kerate.[3] (M.)

Unmetallic. Streak uncolored.
H. 1·0 ... 2·0.
G. 5·5 ... 6·5.

Order IV. Mica. (M.)

Cleavage monotomous.[4]
H. 1·0 ... 4·5.
G. 1·8 ... 3·4.

Order V. Picrosmine.[5] (S.)

When moistened, emits an argillaceous odor.
H. 2·0 ... 3·0.
G. 2·0 ... 2·8.

Order VI. Spar. (M.)

Unmetallic.
H. 3·5 ... 7·0.
G. 2·0 ... 3·7.

---

[2] Βαρὺς, *heavy*.

[3] Κέρας, *horn*.

[4] Μόνος, *single*, and τέμνω, *I cleave*,—implying that the cleavage is distinct only in a single direction.

[5] Πικρὸς, *bitter*, and ὀσμὴ, *odor*,—in allusion to the smell when moistened.

Order VII. Gem. (M.)

Unmetallic. Streak uncolored.
H. 5·5 . . . 10·0.
G. 1·9 . . . 4·7.

Order VIII. Ore. (M.)

H. 1·0 . . . 7·0.
G. 3·4 . . . 7·4.

Order IX. Metal. (M.)

Metallic.
H. 0·0 . . . 5·0.
G. 5·7 . . . 20·0.

Order X. Pyrites. (M.)

Metallic.
H. 3·0 . . . 6·5.
G. 4·1 . . . 7·7.

Order XI. Glance. (M.)

Metallic. Color grey, black.
H. 1·0 . . . 4·0.
G. 4·2 . . . 7·6.

Order XII. Blende. (M.)

H. 1·0 . . . 4·0.
G. 3·9 . . . 8·2.

Order XIII. Sulphur. (M.)

Unmetallic.
H. 1·0 . . . 2·5.
G. 1·9 . . . 2·01.

GENERAL PROPERTIES OF THE ORDERS OF CLASS III.

Order I. Resin. (M.)

H. 0·0 . . . 2·5.
G. 0·7 . . . 1·6.

Order II. Coal. (M.)

Streak brown, black.
H. 1·0 . . . 2·5.
G. 1·2 . . . 1·6.

GENERAL PROPERTIES OF THE GENERA OF CLASS I. *with an enumeration of the Species they contain.*

I. GAS.

Gen. I. Hydrogen Gas. (M.) Odor disagreeable.

Sp. 1. Pure (M.) *Hydrogen.*
2. Empyreumatic (M.) *Carburetted Hydrogen.*
3. Sulphuretted (M.) *Sulphuretted Hydrogen.*
4. Phosphuretted (M.) *Phosphuretted Hydrogen.*

Gen. II. Oxygen Gas. (S.)

Sp. 1. Pure (S.) *Oxygen.*

Gen. III. Nitrogen-Gas. (S.)

Sp. 1. Pure (S.) *Nitrogen.*

Gen. IV. Atmospheric-Gas. (M.)

Sp. 1. Pure (M.) *Atmospheric Air.*

II. WATER.

Gen. I. Atmospheric-Water. (M.)

Sp. 1. Pure (M.) *Water.*

III. ACID.

Gen. I. Carbonic-Acid. (M.)

Sp. 1. Aeriform (M.) *Carbonic Acid.*

Gen. II. Muriatic-Acid. (M.)

Sp. 1. Aeriform (M.) *Muriatic Acid.*

Gen. III. Sulphurous-Acid. (M.)

Sp. 1. Aeriform (M.) *Sulphurous Acid.*
2. Liquid (M.) *Sulphuric Acid.*

Gen. IV. Boracic-Acid. (M.)

Sp. 1. Prismatic[6] (M.) *Sassolin.*

Gen. V. Arsenic-Acid. (M.)

Sp. 1. Octahedral[7] (M.) *White Arsenic.*

IV. SALT.

Gen. I. Natron-Salt. (M.) Taste pungent, alkaline. H. 1·0...1·5. G. 1·4...1·5.

Sp. 1. Peritomous[8] (S.) *Gay Lussite.*
2. Hemi-prismatic[9] (M.) *Natron.*
3. Tetarto-prismatic[10] (S.) *Trona.*

---

[6] Applied to crystals derived from the right rhombic prism.

[7] Applied to crystals derived from the regular octahedron.

[8] Περι, *around*, and τεμνω, *I cleave*,—implying that the cleavage takes place in more than one direction parallel to the axis, and that the faces are all of the same quality. The result of the cleavage is a vertical prism.

[9] Ἡμι, *half*, applied to oblique rhombic prisms.

[10] Τέταρτος, *fourth*, applied to oblique rhombic prisms.

Gen. II. Earthy-Salt. (S.) Deliquescent.

Sp. 1. Calcareous (S.) *Nitrocalcite.* (S.)
2. Magnesian (S.) *Nitro-Magnesite.* (S.)

Gen. III. Glauber-Salt. (M.) Taste cool, then saline and bitter: weak. H. 1·5...2·0. G. 1·4...1·5.

Sp. 1. Prismatic (M.) *Glauber-Salt.*
2. Prismatoidal[11] (S.) *Aphthitalite*[12] (Beu.)

Gen. IV. Nitre-Salt. (M.) Taste saline and cool. H. 2·0. G. 1·9...2·0.

Sp. 1. Prismatic (M.) *Nitre.*
2. Rhombohedral[13] (S.) *Soda Nitre.* (S.)

Gen. V. Rock-Salt. (M.)

Sp. 1. Hexahedral[14] (M.) *Common Salt.*

Gen. VI. Ammonia-Salt. (M.)

Sp. 1. Octahedral (M.) *Sal-Ammoniac.*

Gen. VII. Vitriol-Salt. (M.) Taste astringent. H. 2·0 ...2·5. G. 1·8...2·3.

Sp. 1. Hemi-prismatic (M.) *Copperas.*
2. ——— *White Copperas.*
3. Paratomous[15] (S.) *Botryogene.* (Haid.)
4. Tetarto-prismatic (M.) *Blue Vitriol.*

---

[11] Alluding to a single cleavage, parallel to the axis.

[12] Αφθιτος, *unalterable*, and αλς, *salt.*

[13] Implying the connexion of the forms with the rhomboid.

[14] Implying the connexion of the forms with the cube.

[15] Παρὰ, *about*, and τεμνω, *I cleave*, referring to faces of cleavage of an indeterminate number.

5. Prismatoidal (S.)	*Brochantite.* (Levy.)
6. Prismatic (M.)	*White Vitriol.*
7. Staphyline[16] (S.)	*Cobalt Vitriol.*
8. Habroneme[17] (S.)	*Uranium Vitriol.*

Gen. VIII. Uranium Salt. (S.)

Sp. 1. Cupric (S.)	*Johannite.*

Gen. IX. Bitter-Salt. (M.) Taste saline, bitter. H. 2·0...2·5. G. 1·7...1·8.

Sp. 1. Prismatic (M.)	*Epsom Salt.*
2. Volatile (S.)	*Mascagnine.* (Reuss.)

Gen. X. Alum-Salt. Taste sweetish, astringent. H. 2·0. 2·5. G. 1·7...1·8.

Sp. 1. Octahedral (M.)	*Alum.*
2. Prismatic (S.)	*Solfatarite.*[18] (S.)

Gen. XI. Borax-Salt. (M.)

Sp. 1. Prismatic (M.)	*Borax.*

Gen. XII. Brithyne[19]-Salt. (M.) Taste saline, feebly astringent. H. 2·5...3·0. G. 2·75...2·85.

Sp. 1. Peritomous (S.)	*Thénardite.*
2. Prismatic (M.)	*Glauberite.*
3. Stelene[20] (S.)	*Polyhallite.*

---

[16] Σταφυλή, *a bunch of grapes*, alluding to botryoidal shapes.

[17] Ἁβρός, *delicate*, and νῆμα, *a thread* or *fibre*.

[18] From the solfataras, in which the mineral is chiefly found.

[19] Βριθύς, *dense*, (heavy.)

[20] Στήλη, *a column*, in allusion to the columnar structure of the mineral.

GENERAL PROPERTIES OF THE GENERA OF CLASS II.

HALOIDE.

Gen. I. Cryone[21]-Haloide. (M.)

Sp. 1. Orthotypous[22] (M.) *Cryolite.*

Gen. II. Alum-Haloide. (M.)

Sp. 1. Rhombohedral *Alum-Stone.*

Gen. III. Malachite-Haloide. (S.) Color green, or bluish green. H. 2·0...3·0. G. 2·3...3·0.

Sp. 1. Staphyline (S.) *Chrysocolla.*
2. Lirocone[23] (S.) *Liroconite.*
3. Hexahedral (S.) *Cube Ore.*
4. Prismatic (S.) *Skorodite.*
5. Habroneme (S.) *Nickel Green.*

Gen. IV. Fluor-Haloide. (M.) H. 4·0...5·0. G. 3·0...3·3.

Sp. 1. Octahedral (M.) *Fluor.*
2. Rhombohedral (M.) *Apatite.*
3. Prismatic (S.) *Herderite.*
4. ——— *Fluellite.*
5. Hemi-prismatic (S.) *Yttrocerite.*

Gen. V. Lime-Haloide. (M.) H. 3·0...4·5. G. 2·5...3·2.

Sp. 1. Prismatic (M.) *Arragonite.*

---

[21] Κρύος, *ice*, in allusion to the easy fusibility of the mineral.

[22] Ορθὸς, *straight*, and τυπος, *form*, in allusion to the perpendicular cleavage of the mineral.

[23] Λειρὸς, *pale*, and χονία, *powder*, or *dust.*

2. Rhombohedral (M.)	*Calcareous Spar.*
3. Macrotypous [24] (M.)	*Dolomite.*
4. Brachytypous [25] (M.)	*Rhomb Spar.*
5. Paratomous (M.)	*Ankerite.*
6. Microtine [26] (S.)	*Plumbocalcite.* (Turner.)
7. Staphyline (S.)	*Magnesite.*

BARYTE.

Gen. I. Parachrose [27]-Baryte. (M.) H. 3·5...6·0. G. 3·3...3·9.

Sp. 1. Macrotypous (M.)	*Diallogite.*
2. Brachytypous (M.)	*Spathic Iron.*
3. Rhombohedral (S.)	*Troostite.* (S.)
4. Prismatic (S.)	*Triplite.*
5. Tetarto-prismatic (S.)	*Manganese Spar.*
6. Staphyline (S.)	*Bustamite.*

Gen. II. Zinc-Baryte. (M.) H. 5·0. G. 3·3...4·5.

Sp. 1. Prismatic (M.)	*Electric Calamine.*
2. Axotomous [28] (S.)	*Willemite.*
3. Rhombohedral (M.)	*Calamine.*

---

[24] Μακρὸς, *long*, and τυπος, *form.*

[25] Βραχὺς, *short*, and τυπος, *form.*

[26] Μικρὸς, *small*, alluding to the minuteness of the crystals.

[27] Παράχρωσις, *change of color*, from the alteration in color which the species undergo from exposure to the weather.

[28] Ἄξων, *the axis*, and τεμνω, *I cleave;* the cleavage consisting of a single face, which is perpendicular to the axis.

Gen. III. Tungstic Baryte. (M.) H. 4·0...5·5. G. 4·5...6·1.

Sp. 1.	Pyramidal[29] (M.)	*Tungsten.*
2.	Prismatic (S.)	*Xenotime.*[30] (Beu.)
3.	Octahedral (S.)	*Microlite.* (S.)
4.	Peritomous (S.)	*Thorite.*
5.	Rhombohedral (S.)	*Flucerine.*
6.	Tetarto-prismatic (S.)	*Monazite.* (B.)

Gen. IV. Hal-Baryte. (M.) Prismatic and hemi-prismatic. H. 3·0...4·0. G. 3·6...4·7.

Sp. 1.	Peritomous (M.)	*Strontianite.*
2.	Hemi-prismatic (M.)	*Baryto-Calcite.*
3.	Di-prismatic[31] (M.)	*Witherite.*
4.	Prismatic (M.)	*Heavy Spar.*
5.	Prismatoidal (M.)	*Celestine.*

Gen. V. Lead-Baryte. (M.) H. 2·5...4·0. G. 5·4...7·3.

Sp. 1.	Peritomous (M.)	*Kerasite.*
2.	Kerasine (S.)	*Corneous Lead.*
3.	Di-prismatic (M.)	*White Lead Ore.*

---

[29] Applied to crystals derived from the right square prism, and from the octahedron with a square base.

[30] Κενὸς, *vain*, and τιμὴ, *honor;* in allusion to the circumstance that the phosphate of yttria, of which this mineral consists, was for a time regarded as the oxide of a new metal, the Thorium.

[31] When the cleavages are parallel to the sides of a four-sided vertical prism, and at the same time to a horizontal prism.

4.	Hedyphanous (S.)	*Hedyphane.*
5.	Pyromorphous[33] (S.)	*Pyromorphite.*
6.	Staphyline (S.)	*Plumbo-Gummite.* (S.)
7.	Hemi-prismatic (M.)	*Red Lead-Ore.*
8.	Pyramidal (M.)	*Yellow Lead-Ore.* (S.)
9.	Tungstic (S.)	*Scheeletine.* (Beu.)
10.	Prismatic (M.)	*Anglesite.* (Beu.)
11.	Axotomous (M.)	*Leadhillite.* (Beu.)
12.	Prismatoidal (S.)	*Dyoxylite.*[34] (B.)
13.	Cupreous (S.)	*Caledonite.* (Beu.)
14.	Euotomous[35] (S.)	*Cupreous Anglesite.*
15.	———	*Vauquelinite.*

Gen. VI. Copper-Baryte. (S.) Color blue and green.
H. 2·5 . . . 5·0. G. 3·2 . . . 4·6.

Sp. 1.	Prismatic (S.)	*Olivinite.*
2.	Di-prismatic (S.)	*Libethenite.*
3.	Aphanistic[36] (S.)	*Aphanesite.*
4.	Azure (S.)	*Blue Malachite.*
5.	Rhombohedral (S.)	*Dioptase.*
6.	Peritomous (S.)	*Euchroite.*
7.	Hemi-prismatic (S.)	*Pseudo Malachite.*

---

[33] Πυρ, *fire*, and μορφὴ, *form*, referring to its crystallization from fire.

[34] Δὶς, *twice*, and ὀξὺς, *acid*, from its containing two acids.

[35] Ευ, *well*, and τέμνω, *I cleave*, from the distinctness of the cleavages.

[36] Αφανὴς, *indistinct.*

8. Habroneme (S.) *Green Malachite.*
9. Prismatoidal (S.) *Atacamite.*
10. Dystome[37] (S.) *Erinite.*

Gen. VII. Tellurium-Baryte. (S.)

Sp. 1. Staphyline (S.) *Herrerite.*

Gen. VIII. Bismuth-Baryte. (S.)

Sp. 1. Tetrahedral (S.) *Bismuth-Blende.*

Gen. IX. Antimony-Baryte. (M.)

Sp. 1. Prismatic (M.) *White Antimony.*

KERATE.

Gen. I. Pearl Kerate. (M.) H. 1·0...2·0. G. 5·5...6·5.

Sp. 1. Hexahedral (M.) *Horn Silver.*
2. Pyramidal (M.) *Horn Quick Silver.*
3. Monotomous (S.) *Iodic Silver.*

MICA.

Gen. I. Euchlore[38]-Mica. (M.) Color green and yellow. H. 1·0...2·5. G. 2·5...3·2.

Sp. 1. Rhombohedral (M.) *Copper Mica.*
2. Prismatic (M.) *Kupaphrite.* (S.)
3. Pyramidal (M.) *Uranite.*

---

[37] Δυς, *with difficulty*, and τέμνω, *I cleave.*

[38] Ευ, *well*, and χλωρὸς, *green*, from the distinctness of the green color.

Gen. II. Cobalt-Mica. (M.)

Sp. 1. Diatomous[39] *Cobalt Bloom.*

Gen. III. Pyrosmalite-Mica. (B.)

Sp. 1. Hexagonal (B.) *Pyrosmalite.*

Gen. IV. Iron-Mica. (M.) H. 2·0...2·5. G. 2·6 ...2·7.

Sp. 1. Prismatic (M.) *Vivianite.*
2. Rhombohedral (S.) *Cronstedite.*

Gen. V. Graphite-Mica. (M.)

Sp. 1. Rhombohedral (M.) *Plumbago.*

Gen. VI. Talc-Mica. (M.) H. 1·0...2·5. G. 2·4 ...3·0.

Sp. 1. Prismatic (M.) *Talc.*
2. Rhombohedral (M.) *Mica.*

Gen. VII. Gypsum-Mica. (S.) H. 1·0...3·5. G. 2·3...3·0.

Sp. 1. Rhombohedral (S.) *Native Magnesia.*
2. Prismatoidal (S.) *Gypsum.*
3. Prismatic (S.) *Anhydrite.*
4. Diatomous (S.) *Haidingerite.*
5. Hemi-prismatic (S.) *Pharmacolite.*

Gen. VIII. Pearl-Mica. (M.)

Sp. 1. Rhombohedral (M.) *Margarite.*

---

[39] Διὰ, *through*, and τέμνω, *I cleave*,—implying that the crystals possess one distinct diagonal-cleavage.

PICROSMINE.

Gen. I. Atelene[40]-Picrosmine. (S.) Lustre dull. H. 2·5...3·0. G. 2·2...2·6.

Sp. 1. Prismatic (S.)	*Serpentine.*
2. Fibrous (S.)	*Picrolite.*
3. Prismatoidal (S.)	*Picrosmine.*
4. Nemaline[41] (S.)	*Nemalite.*
5. Brittle (S.)	*Kerolite.*
6. Glyptic (S.)	*Figure Stone.*

SPAR.

Gen. I. Schiller-Spar. (M.) Cleavage monotomous. H. 3·5...5·0. G. 2·6...3·3.

Sp. 1. Diatomous (M.)	*Schiller Spar.*
2. Hemi-prismatic (M.)	*Bronzite.*

Gen. II. Disthene-Spar. (M.) H. 5·0...7·0. G. 3·0...3·7.

Sp. 1. Prismatic (M.)	*Kyanite.*
2. Prismatoidal (S.)	*Spodumene.*

Gen. III. Dystome-Spar. (M.) H. 5·0...7·0. G. 2·8...3·0.

Sp. 1. Prismatic (M.)	*Datholite.*
2. Pyramidal (S.)	*Gehlenite.*
3. Periotomous (S.)	*Edingtonite.*

---

[40] Ατελὴς, *imperfect;* in allusion to the want of regular forms in the genus.

[41] Νῆμα, *a thread,*—from the fibrous structure.

Gen. IV. Wavelline-Spar. (S.) Botryoidal, and columnar. H. 3·0...4·5. G. 1·85...3·00.

Sp. 1.	Staphyline (S.)	*Gibbsite.*
2.	Uncleavable (S.)	*Allophane.*
3.	Prismatic (S.)	*Wavellite.*
4.	Prismatoidal (S.)	*Karpholite.*
5.	Hemi-prismatic (S.)	*Cummingtonite.*
6.	Tetarto-prismatic (S.)	*Diaspore.*

Gen. V. Kouphone-Spar. (M.) H. 3·5...6·0. G. 2·0...2·5.

Sp. 1.	Axotomous (M.)	*Prehnite.*
2.	Abrazitic[42] (S.)	*Gismondin.*
3.	Trapezohedral (S.)	*Leucite.*
4.	Dodecahedral (M.)	*Sodalite.*
5.	Hexahedral (M.)	*Analcime.*
6.	Paratomous (M.)	*Harmotome.*
7.	Vesuvian (S.)	*Comptonite.*
8.	Staurotypous[43] (M.)	*Phillipsite.*
9.	Rhombohedral (M.)	*Chabasie.*
10.	Sarcoline[44] (S.)	*Gmelinite.*
11.	Macrotypous (M.)	*Levyne.*
12.	Diatomous (M.)	*Laumonite.*
13.	Prismatic (M.)	*Mesotype.*
14.	Orthotomous (M.)	*Thomsonite.*
15.	Prismatoidal (M.)	*Stilbite.*

---

[42] A and Βράζω, *to bubble*, from the fact that it does not effervesce when melted before the blow-pipe.

[43] Σταυρὸς, *a cross*, and τύπος, *a form*, in allusion to the cross form of its macles.

[44] Σὰρξ, *flesh*, from its reddish white color.

16. Hemi-prismatic (M.) *Heulandite.*
17. Diplogenous (M.) *Epistilbite.*
18. Polyprismatic[45] (S.) *Brewsterite.*
19. Pyramidal (M.) *Apophyllite.*

Gen. VI. Azure-Spar. (M.) Color blue. H. 5·0... 6·0. G. 2·83...3·10.

Sp. 1. Prismatic (M.) *Lazulite.*
2. Prismatoidal (M.) *Blue Feldspar.*
3. Uncleavable (S.) *Turquoise.*

Gen. VII. Feld-Spar. (M.) H. 5·0...6·0. G. 2·5 ...3·1.

Sp. 1. Rhombohedral (M.) *Nepheline.*
2. Orthotomous (M.) *Feldspar.*
3. Heterotomous[46] (M.) *Periklin.*
4. Tetarto-prismatic (M.) *Albite.*
5. Anorthotomous (M.) *Anorthite.*
6. Polychromatic[47] (M.) *Labradorite.*
7. Eruthrone[48] (S.) *Latrobite.*

Gen. VIII. Andalusite-Spar. (M.)

Sp. 1. Prismatic (M.) *Andalusite.*

---

[45] Πολὺς, *many*, in allusion to the numerous prisms its crystals present in a single form.

[46] Ἕτερος, *another*, and τέμνω, *I cleave*, in allusion to its having a different cleavage from Feldspar.

[47] Πολὺς, *many*, and χρωμα, *color*, in allusion to the play of colors it presents.

[48] Ερυθρὸς, *red.*

Gen. IX. PETALINE-SPAR. (M.) H. 5·0...6·5. G. 2·8...3·2.

Sp. 1.	Uncleavable (S.)	*Nephrite.*
2.	Dusclaone (S.)	*Saussurite.*
3.	Prismatic (M.)	*Petalite.*
4.	Rhombohedral (S.)	*Eudyalite.*
5.	Pyramidal (S.)	*Scapolite.*
6.	Peritomous (S.)	*Fahlunite.*
7.	Prismatoidal (S.)	*Amblygonite.*

Gen. X. AUGITE-SPAR. (M.) H. 4·5...7·0. G. 2·7...3·5.

Sp. 1.	Prismatoidal (M.)	*Epidote.*
2.	Dystome (H.)	*Bucklandite.*
3.	Paratomous (M.)	*Pyroxene.*
4.	Achmitic (S.)	*Achmite.*
5.	Axotomous (M.)	*Babingtonite.*
6.	Hemi-prismatic (M.)	*Hornblende.*
7.	Peritomous (M.)	*Arfwedsonite.*
8.	Metalloidal (S.)	*Hypersthene.*

Gen. XI. TABULAR-SPAR. (S.) H. 3·5...6·0. G. 2·0...2·9.

Sp. 1.	Tetarto-prismatic (S.)	*Tabular Spar.*
2.	Prismatic (S.)	*Pyrallolite.*
3.	Parachrose (S.)	*Boltonite.*

GEM.

Gen. 1. CORUNDUM. (M.) H. 7·0...9·0. G. 3·5...4·6.

Sp. 1.	Dodecahedral (M.)	*Spinel.*
2.	Octahedral (M.)	*Automolite.*
3.	Rhombohedral (M.)	*Corundum.*

Gen. II. Diamond. (M.)

Sp. 1. Octahedral (M.) *Diamond.*

Gen. III. Topaz. (M.)

Sp. 1. Prismatic (M.) *Topaz.*

Gen. IV. Emerald. (M.) H. 7·5 ... 8·0. G. 2·6 ... 3·2.

Sp. 1. Prismatic (M.) *Euclase.*
2. Rhombohedral (M.) *Emerald.*
3. Pyramidal (S.) *Chrysoberyl.*
4. Phenakine (S.) *Phenakite.*
(Nordenskiöld.)

Gen. V. Quartz. (M.) H. 5·5 ... 7·5. G. 1·9 ... 2·7.

Sp. 1. Prismatic (M.) *Iolite.*
2. Rhombohedral (M.) *Quartz.*
3. Uncleavable (M.) *Opal.*
4. Empyrodox[49] (M.) *Pitchstone.*
5. Isopyric (H.) *Isopyre.*

Gen. VI. Axinite. (M.) Color brown. H. 6·5 ... 7·0.
G. 3·0 ... 3·3.

Sp. 1. Tetarto-prismatic (S.) *Axinite.*
2. Prismatoidal (S.) *Bucholzite.*

Gen. VII. Chrysolite. (M.)

Sp. 1. Prismatic (M.) *Peridot.*

Gen. VIII. Boracite.

Sp. 1. Tetrahedral (M.) *Boracite.*

---

[49] Εμπυρὸς, *belonging to fire*, and ὀόξα, *opinion.*

Gen. IX. Tourmaline. (M.) H. 7·0...7·5. G. 3·0 ...3·2.

Sp. 1. Rhombohedral (M.)	*Tourmaline.*
2. Hemi-prismatic (S.)	*Brucite.*
3. Pyramidal (S.)	*Idocrase.*

Gen. X. Garnet. H. 6·0...7·5. G. 3·1...4·3.

Sp. 1. Tetrahedral (M.)	*Helvin.*
2. Dodecahedral (M.)	*Garnet.*
3. Pyramidal (M.)	*Zircon.*
4. Prismatoidal (S.)	*Staurotide.*

ORE.

Gen. I. Melane[50]-Ore. (P.) H. 6·0...7·0. G. 4·0 ...4·3.

Sp. 1. Tetarto-prismatic (P.)	*Allanite.*
2. Hemi-prismatic (P.)	*Gadolinite.*

Gen. II. Eruthrone-Ore. (S.) Some shade of red or brown. H. 3·5...7·0. G. 3·4...7·1.

Sp. 1. Prismatic (S.)	*Sphene.*
2. Pyramidal (S.)	*Anatase.*
3. Prismtoidal (S.)	*Aischynite.* (Berz.)
4. Pyrochlore (S.)	*Pyrochlore.*
5. Melanous (S.)	*Polymignite.* (Berz.)
6. Diatomous (S.)	*Brookite.*
7. Peritomous (S.)	*Rutile.*
8. Octahedral (S.)	*Red Copper-Ore.*
9. Hemi-prismatic (S.)	*Red Zinc-Ore.*

---

[50] Μέλας, *Black.*

10.	Uncleavable (S.)	*Cerite.*
11.	Monotomous (S.)	*Yttro-Tantalite.*

Gen. III. Iron-Ore. (M.) H. 5·0...6.5. G. 3·8...5·3.

Sp. 1.	Octahedral (M)	*Magnetic Iron.*
2.	Chromated (S.)	*Chrome-Ore.*
3.	Dodecahedral (M.)	*Franklinite.*
4.	Axotomous (M.)	*Crichtonite.*
5.	Uncleavable (S)	*Mohsite.*
6.	Rhombohedral (M.)	*Specular Iron.*
7.	Prismatic (M)	*Limonite.*
8.	Di-prismatic (M.)	*Yenite.*

Gen. IV. Baryte-Ore. (S.) H. 5 0.., 6·0. G. 6·0 ...7·4.

Sp. 1.	Peritomous (S)	*Tin-Ore.*
2.	Prismatic (S)	*Wolfram.*
3.	Pyramidal (S)	*Columbite.*
4.	Uncleavable (S.)	*Pitchblende.*

Gen. V. Manganese-Ore. (M) Color black. H. 2·0 ...6 5. G. 3 1...4 9.

Sp. 1.	Pyramidal (M)	*Black Manganese.*
2.	Brachytipous (M)	*Braunite.*
3.	Uncleavable (M)	*Psilomelane.*
4.	Prismatoidal (M.)	*Manganite.*
5.	Prismatic (M.)	*Pyrolusite.*
6.	Staphyline (S)	*Cupreous Manganese.*

Gen. VI. Lusine[51]-Ore. (S.) Pulverulent.

Sp. 1.	Bismuthic (S.)	*Bismuth Ochre.*
2.	Tungstic (S.)	*Tungstic Ochre.*
3.	Molybdic (S.)	*Molybdic-Ochre.*
4.	Uranic (S.)	*Uranic-Ochre.*
5.	Chromic (S.)	*Chrome-Ochre.*
6.	Cobaltic (S.)	*Earthy Cobalt.*
7.	Cupric (S.)	*Melaconite.*[52] (Beu.)
8.	Plumbic (S.)	*Minium.*
9.	Antimonic (S.)	*Antimony-Ochre.*

METAL.

Gen. I. Malacone[53]-Metal. (S.) Color white, reddish and yellow. H. 0·0...3·5. G. 6·0...14·8.

Sp. 1.	Auro-tellurium (S.)	*Mullerite.*[54] (Beu.)
2.	Tellurium (S.)	*Native Tellurium.*
3.	Bismuth (S.)	*Native Bismuth.*
4.	Mercury (S.)	*Native Mercury.*
5.	Argento-mercury (S.)	*Native Amalgam.*
6.	Argento-antimony (S.)	*Antimonial Silver.*
7.	Silver (S.)	*Native Silver.*
8.	Copper (S.)	*Native Copper.*
9.	Gold (S.)	*Native Gold.*
10.	Arsenic (S.)	*Native Arsenic.*
11.	Antimony (S.)	*Native Antimony.*

---

[51] Λύσις, *decomposition*, from the circumstance that the species of this genus result from the decomposition of other species.

[52] Μέλας, *black*, and κονία, *powder*.

[53] Μαλαχὸς, *soft*.

[54] The discoverer's name.

Genus II. SCLERONE[55] METAL. (S.) H. 4·0...5·0. G. 7·31...18·5.

Sp. 1. Iron (S.)	*Native Iron.*
2. Platina (S.)	*Native Platina.*
3. Iridium (S.)	*Native Iridium.*
4. Irid-osmium (S.)	*Irid-Osmine.*
5. Palladium (S.)	*Native Palladium.*

PYRITES.

Gen. I. ERUTHLEUCONE[56]-PYRITES. (S.) Color white to red. H. 5·0...6·0. G. 5·7...7·0.

Sp. 1. Cupreous (S.)	*Copper Nickel.*
2. Euotomous (S.)	*Nickel Glance.*
3. Antimonial (S.)	*Nickel Stibine.* (BEU.)
4. Axotomous (S.)	*Leucopyrite.*[57] (S.)
5. Prismatic (S.)	*Mispickel.*
6. Cobaltic (S.)	*Cobalt Pyrites.*
7. Octahedral (S.)	*Smaltine.* (BEU.)
8. Hexahedral (S.)	*Cobaltine.* (BEU.)

Gen. II. CHLORONE[58]-PYRITES. (S.) Color greenish yellow. H. 3·0...6·5. G. 4·1...5·1.

Sp. 1. Hexahedral (S.)	*Iron Pyrites.*
2. Pyramidal (S.)	*Yellow CopperPyrites.*
3. Prismatic (S.)	*White Iron-Pyrites.*
4. Capillary (S.)	*Capillary Pyrites.*

---

[55] Σκληρὸς, *hard.*

[56] Ερυθρὸς, *red,* and λευκὸς, *white,* the color being a mixture of red and white.

[57] Λευκὸς, *white,* and πυριτης, *a stone emitting fire.*

[58] Χλωρὸς, *yellowish green.*

Gen. III. Bronze-Pyrites. (S.) Color bronze. H. 3·5...4·0. G. 4·1...4·7.

Sp. 1.	Rhombohedral (S.)	*Magnetic Iron Pyrites.*
2.	Octahedral (S.)	*Variegated Copper.*

GLANCE.

Gen. 1. Copper-Glance. (M.) H. 2·5...4·0. G. 4·3...5·8.

Sp. 1.	Hexahedral (M.)	*Tin Pyrites.*
2.	Tetrahedral (M.)	*Fahlerz.*
3.	Di-prismatic (M.)	*Bournonite.*
4.	Prismatic (M.)	*Vitreous Copper.*

Gen. II. Polypoione[59]-Glance. (S.) H. 1·0...2·5. G. 4·5...8·5.

Sp. 1.	Prismatoidal (S.)	*Black Silver.*
2.	Dodecahedral (S.)	*Vitreous Silver.*
3.	Hexahedral (S.)	*Galena.*
4.	Selenious (S.)	*Eukairite.*
5.	Paratomous (S.)	*Clausthalite.*[60] (Beu.)
6.	Prismatic (S.)	*Black Tellurium.*
7.	Telluric (S.)	*Telluric Silver.*
8.	Bismuthic (S.)	*Bornite.*[61] (Beu.)
9.	Uncleavable (S.)	*Stromeyerite.*
10.	Cupreous (S.)	*Cupreous Bismuth.*
11.	Monotomous (S.)	*Sternbergite.*

---

[59] Πολὺς, *many*, and ποίεω, *to make*, in allusion to the number of species in the genus.

[60] From the locality.

[61] Named from De Born.

12. Rhombohedral (S.) *Molybdenite.*
13. Axotomous (S.) *Polybasite.*[62]

Gen. III. Antimony-Glance. (M.) H. 1·5...2·5. G. 4·2...5 8.

Sp. 1. Prismatic (M.) *Graphic Gold.*
2. Prismatoidal (M.) *Grey Antimony.*
3. Axotomous (M.) *Jamesonite.*
4. Peritomous (P.) *Zinkenite.*[63]

BLENDE.

Gen. I. Sclerone-Blende. (S.) H. 3·5...4·0. G. 3·9...4·2.

Sp. 1. Hexahedral (S.) *Manganblende.*
2. Dodecahedral (S.) *Blende.*

Gen. II. Malacone-Blende. (S.) H. 1·0...2·5. G. 4·5...8·2.

Sp. 1. Prismatic (S.) *Red Antimony.*
2. Rhombohedral (S.) *Red Silver.*
3. Aphotistic[64] (S.) *Proustite.* (Beu.)
4. Hemi-prismatic (S.) *Myargyrite.*
5. Peritomous (S.) *Cinnabar.*
6. Selenious (S.) *Rionite.*[65] (S.)
7. Yellow (S.) *Orpiment.*
8. Red (S.) *Realgar.*

---

[62] Πολὺς, *many*, and Βάσις, *base*, having many bases in its composition.

[63] Named from Zinken, its discoverer.

[64] A and φως, *void of light*, from its dark color.

[65] Named from Del Rio.

SULPHUR.

Gen. I. Brittle Sulphur. (S.)

Sp. 1. Prismatic (S.) *Sulphur.*
2. Selenious (S.) *Sulpho-Selenite.* (S.)

GENERAL PROPERTIES OF THE GENERA IN CLASS III.

RESIN.

Gen. I. Melichrone[66]-Resin. (M.)

Sp. 1. Pyramidal (M.) *Mellite.*

Gen. II. Mineral Resin. (M.) H. 0·0...2·5. G. 0·8...1·2.

Sp. 1. Yellow (M.) *Amber.*
Black (M.) *Bitumen.*

COAL.

Gen. I. Mineral-Coal. (M.) H. 1·0.

Sp. 1. Bituminous (M.) *Bituminous Coal.*
2. Non-bituminous (M.) *Anthracite.*

---

[66] Μελιχρων, *having the color of honey.*

UNIVERSITY OF CALIFORNIA

GENERAL DESCRIPTIONS

OF THE

SPECIES.

ABRAZITE. (See *Gismondin.*)

ACHMITE. Achmitic Augite-Spar.

Primary form. Oblique rhombic prism. M on M = 93° 4′.

Secondary form. The primary, having the obtuse lateral edges deeply truncated, together with the edges of the base in such a manner as to give rise to a very acute 4-sided summit: the acute lateral edges also slightly truncated in some instances.

Cleavage, parallel with M distinct; traces, parallel with the diagonals. Fracture imperfectly conchoidal. Surface, broad secondary lateral planes streaked longitudinally; the rest, smooth and shining.

Lustre vitreous. Color brownish-black, with a tinge of yellow or green. Streak pale yellowish-grey. Translucent on the edges, to opake.

Brittle. Hardness = 6·0...6·5. Sp. gr. = 3·2...3·3.

1. Before the blow-pipe it melts into a black globule, which moves the magnetic needle. It affords no moisture by calcination, and is not attacked by the acids.

2. *Analysis.*

By BERZELIUS.

Silica	55·25
Peroxide of iron	31·25
Soda	10·40
Lime	0.72
Protoxide of manganese,	1·08

3. It is found engaged in Quartz near Kongsberg in Norway.

4. This mineral has been referred to Pyroxene by several mineralogists, from which substance, however, it appears sufficiently distinct.

ACHYRITE. (See *Dioptase.*)

ACICULAR BISMUTH GLANCE. (See *Needle-Ore.*)

ACTINOTE. (See *Hornblende.*)

ACTYNOLITE. (See *Hornblende.*)

ADAMANTINE-SPAR. (See *Corundum.*)

ADINOLE. (See *Petrosilex.*)

ADIPOCIRE MINERAL. (See *Hatchetine.*)

ADULARIA.

The most transparent and pure varieties of *Albite* and *Feldspar*, q. v.

AEQUINOLITE. (See *Pitchstone.*)

AEROSITE. (See *Red Silver.*)

AGALMATOLITE. (See *Figure-stone.*)

AGARIC MINERAL. (See *Calcareous Spar.*)

AGATE. (See *Quartz.*)

AISCHYNITE. Prismatoidal Eruthrone-Ore.

Primary form. Right rhombic prism.

Secondary form. The primary, terminated by 4-sided pyramids.

Lustre sub-metallic. Color black. Streak dark grey to black.

Hardness $=5{\cdot}0\ldots7{\cdot}0$. Sp. gr. $=5{\cdot}14\ldots5{\cdot}55$.

1. In the matrass, it yields a little moisture, without altering its appearance. In an open tube it affords distinct traces of Fluoric acid. At an incipient red heat, upon charcoal, or in the platina forceps, it puffs up and enlarges in all its dimensions, especially in the direction of its cleavage, curls over to one side and remains without fusing of a dull yellow color. With borax, it is dissolved in large quantities; the glass presenting a dark yellow color both in the oxidation and reduction fire of the blow-pipe. When the mineral is added in excess, the glass after cool-

ing becomes opake. It is easily soluble into a clear and colorless glass with the salt of phosphorus. With soda, it is decomposed, without suffering fusion.

2. *Analysis.*

By HARTWALL.

Titanic acid	56·00
Zirconia	20·00
Oxide of cerium	15·00
Lime	3·80
Oxide of iron	2·60
Oxide of tin	0·50

3. It was brought from Mias in the Ural mountains of Siberia, by MENGE.

ALBIN. (See *Apophyllite.*)

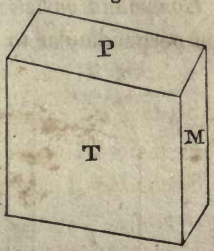
ALBITE. Tetarto-prismatic Feldspar.

PARTSCH.

Primary form. Doubly oblique prism.

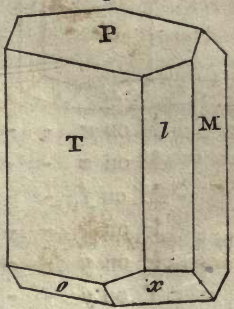
M on T	117°	53′
M on P	93	30
T on P	115	5

Fig. 1.



Secondary form.

Fig. 2.



M on *l*	119°	52′
P on *l*	119	51
P on *x*	127	23
T on *x*	110	29

Albite.

Cleavage, parallel to P perfect; parallel to the faces M and T less perfect, though frequently obtained with sufficient precision to admit of the application of the reflective goniometer.

Fracture uneven, imperfectly conchoidal.

Surface slightly rough or streaked upon some of the primary faces, but even.

Lustre vitreous, often inclining to pearly upon perfect faces of cleavage. Color white, passing into grey, red and green. Streak white. Transparent in small crystals,... translucent on the edges. A bluish opalescence is sometimes observable.

Brittle. Hardness = 2·613 (small transparent crystals from Dauphiny.) Limits 2·61 ... 2·68.

Compound varieties. Twin-crystals. Axis of revolution perpendicular to the prismatic axis.

Fig. 3.

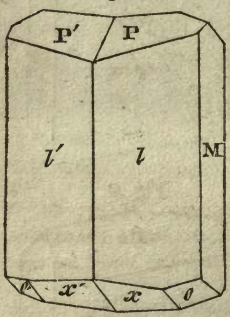
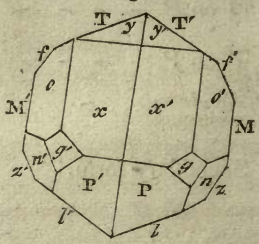


Fig. 4.



M on *g*	- - - - - - - -	100	52
M on *z*	- - - - - - - -	149	12
M' on *f*	- - - - - - - -	148	30
P on *g*	- - - - - - - -	150	5
P on *y*	- - - - - - - -	97	37
T on *y*	- - - - - - - -	134	32

Albite.

Twin-crystals, like the above figures, and others still more complicated, are of frequent occurrence, compared with simple forms.

Massive: composition granular; individuals of various sizes, commonly compressed parallel to T, in which case the composition assumes a lamellar appearance; the lamellæ being arranged somewhat in a stellular manner. The composition rarely approaches the impalpable, in which case it becomes strongly coherent.

1. Before the blow-pipe on charcoal, it becomes glassy, semi-transparent and white; but melts with difficulty only on its edges into a semi-transparent, vesicular glass. It is dissolved by borax, but slowly and without effervescence. If the borax be previously mingled with oxide of nickel, the resulting globule will present a brown color.

2. *Analysis.*

	By Eggertz, from Finbo.	By Rose, from Arendal.	By Stromeyer, from Chesterfield, Mass.
Silica	70·48	68·84	70·68
Alumina	18·45	20·53	19 80
		With a little oxide of iron and lime.	
Soda	10·50	9·12	9·06
Lime	·55	0·00	0·23
Oxide of iron & manganese	0·00	0 00	1·11

3. Albite is found entering into the composition of granite, either along with quartz and mica, or accompanied by feldspar. In general, it would appear, that in those granite veins and beds, where Tourmaline abounds, Albite is substituted for feldspar. Albite is also one of the constituents of sienite and greenstone.

4. The largest crystals of Albite hitherto known, are from Kerabinsk in Siberia. Crystallized varieties are found also in the highest districts of St. Gothard, and the Alps of Savoy. The foliated, massive, and nearly impalpable varieties, occur at Chesterfield and Goshen, (Mass.) associated with Tourmalines of various colors, as also at Paris in Maine; at the former places, small transparent crystals, lining cavities in the massive variety, rarely present themselves: in Middletown, Con., at Had-

dam, Con., in two different localities; the one along with Chrysoberyl and Columbite, where it is almost impalpably massive; the other, one mile and a half S.W., where it occurs in large granular individuals of a greenish white color, associated with Quartz, black Tourmaline, and rarely with the variety of mica called Pinite. A variety similar to that occurring along with the Columbite of Haddam, comes from Finbo and Brodbo in Sweden.

ALLAGITE. (See *Red Manganese-Ore.*)

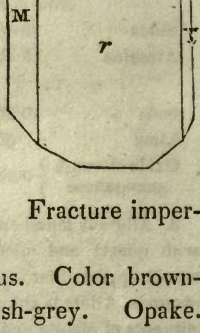
ALLANITE. Tetarto-Prismatic Melane-Ore. PARTSCH.

Primary form. Right oblique-angled prism. M on T $=115°$.

Secondary form.

M on *r*	- - - - - -	116°	00′
T on *r*	- - - - - -	129	00
s on *r*	- - - - - -	135	30
y on *r*	- - - - - -	109	01
s on *x*	- - - - - -	156	45
t on *x*	- - - - - -	164	30
y on *x*	- - - - - -	151	00
y on *t*	- - - - - -	166	30

Fig. 5.



Cleavage, parallel to *r* and M distinct. Fracture imperfectly conchoidal.

Lustre imperfectly metallic to resinous. Color brownish or greenish-black. Streak greenish-grey. Opake. Faintly translucent and brown in thin splinters, to opake.

Brittle. Hardness=6·0. Sp. gr.=4·001.

Compound varieties. In acicular aggregations. Massive. Composition impalpable. Lustre vitreous. Color passing into brown if the mineral be decomposed. Sp. gr. $=3·1....4·0$.

Allanite.

1. Several minerals, proposed by different authors as distinct, appear to fall within the present description. Of these the *Allanite* of THOMSON presents us with the most distinct crystals. The *Orthite* of BERZELIUS owes its diminished sp. gr. to its state of partial decomposition. The *Cerine* of the same author, or the *Cerium oxidé siliceux noir* of HAÜY, is usually compact and black.

2. Allanite froths before the blow-pipe, and melts imperfectly into a black scoria, and it gelatinizes in nitric acid. Orthite froths, becomes yellowish brown, and melts with effervescence into a black vesicular globule; with borax into a transparent one, and gelatinizes in heated acids. The Cerine behaves in a similar manner, but its globule acts upon the magnetic needle.

3. *Analysis.*

	By THOMSON,	By BERZELIUS,	
	Allanite, from Greenland.	*Orthite*, from Finbo.	from Gottliebsgang.
Oxide of cerium	33·90	17·39	19·44
Oxide of iron	25·40	11·42	12·44
Silica	35·40	18·83	32·00
Lime	9·20	4·89	7·84
Alumina	4·10	14·00	14·80
Yttria	00·00	3·80	3·44
Oxide of manganese	00·00	1·36	3.40
Water	00·00	8·70	5·36

	By WOLLASTON.	By HISINGER.
	Allanite, from Myssore.	*Cerine*, from Riddarhytta.
Silica	34·00	30·17
Alumina	9·00	11·31
Oxide of cerium	19·80	28·19
Oxide of iron	32·00	20·72
Lime	00·00	9.12
Oxide of copper	00·00	0·89
Water	00·00	0·40

4. Allanite was first found at Alluk in East Greenland, accompanied by Zircon and Quartz. Orthite occurs at Finbo, near Fahlun in Sweden, along with Quartz, Feldspar and Albite, in gneiss. The Cerine exists in the copper mines of St. Görans at Riddarhytta.

ALLOCHROITE. (See *Garnet.*)

ALLOPHANE. Uncleavable Wavelline-Spar

Reniform, botryoidal, massive; composition impalpable. Fracture conchoidal.

Lustre vitreous, inclining to resinous. Color blue, green, brown and grey. Transparent... translucent on the edges.

Hardness = 3·0 nearly. Sp. gr. = 1·85...1·88.

1. Alone upon charcoal before the blow-pipe, it does not melt, though it swells up, becomes feebly coherent, and communicates to the flame a copper green color. With borax, it fuses with great difficulty into a colorless glass. It is not soluble in soda; but the mass becomes green in the oxidation heat, and red in the reduction flame: on the addition of borax, a speck of metallic copper may be obtained.

2. *Analysis.*

	By Stromeyer, from Saalfeld.		By Ficinus, from Schneeberg.
Alumina	32.202	Hydrate of alumina	34·30
Silica	21·922	Silica	30·
Lime	0·730	Hydrate of copper	23·70
Sulphate of lime	0·517	Carbonate of lime	2·80
Carbonate of copper	3·058	Oxide of manganese	1·80
Hydrate of iron	2·270	Water	7.80
Water	41 301		

3. It is found at Saalfeld in Thuringia, Schneeberg in Saxony, and at Taune in the Hartz.

Almandin. (See *Garnet.*)

ALUM. Octahedral Alum-Salt. Mohs.

Stalactitic: composition columnar or granular, often impalpable. Mealy efflorescence.

Lustre vitreous; if delicately fibrous, pearly; sometimes dull. Color white or greyish white. Transparent... translucent or opake.

Hardness = 2·0...2·5. Sp. gr. = 1·75. Taste sweetish astringent.

Alum—Alum-stone.

1. Alum is very soluble in water, melts before the blow-pipe in its water of crystallization, and is converted into a spongiform mass.

2. *Analysis.*

Potash	9·94
Alumina	10·82
Sulphuric acid	33·77
Water	45·47

3. It occurs in a state of efflorescence upon minerals and rocks which contain alumina, potash and sulphuret of iron; as upon alum-stone, alum-slate and mica-slate: it is also found accompanying brown-coal, and is contained in the waters of certain mineral springs.

4. Alum occurs on the alum-slate rocks near Christiania in Norway, and under the same circumstances as near Moffat in Dumfries-shire, and Ferry-town of Cree in Galloway; on bituminous shale and slate-clay at Hurlet near Paisley in Scotland: in coal mines in Bohemia, Bavaria and Italy; and in various places, too numerous to be mentioned, in New-England, upon mica-slate.

5. This salt, as produced by nature, requires first to be purified, in order to be fitted for the purposes of the arts. Its artificial solution affords it in regular crystals, having the form of the regular octahedron. A great quantity of alum is obtained by the aid of chemical processes. Its uses are various; as for instance, in dyeing, in medicine, for the manufacture of leather and paper, and the prevention of putrefaction.

ALUMINITE. (See *Websterite*.)

ALUM-STONE. Rhombohedral Alum-Haloide. MOHS.

Primary form. Rhomboid. P on P 92° 50′ r. g.

Secondary form. The primary form with one or more of its lateral solid angles replaced by tangent planes.

Cleavage parallel with the tangent secondary planes rather perfect, that parallel with the primary faces indistinct. The primary faces sometimes streaked parallel to the edges of the secondary faces.

Lustre vitreous, inclining to pearly upon the more distinct faces of cleavage. Color white, sometimes reddish or greyish. Streak white. Transparent . . . translucent.

Brittle. Hardness $=5{\cdot}0$. Sp. gr. $=2{\cdot}694$ (a crystallized variety from Tolfa.)

Compound Varieties. Massive: composition small granular, often impalpable; fracture uneven, flat conchoidal, splintery, sometimes earthy.

1. Alone, in the matrass, before the blow-pipe, it at first disengages moisture; but a more intense heat occasions a sublimate of sulphate of ammonia. The crystals decrepitate with great energy when heated, and become reduced to powder like Diaspore. Upon charcoal in a strong heat it contracts, but does not melt. It dissolves however, in borax, with effervescence, and gives rise to a colorless and transparent glass.

2. *Analysis.*

	By Vauquelin.	By Cordier, of the crystals.
Alumina	43·92	39·654
Silica	24·00	0·000
Sulphuric acid	25·00	35·495
Potash	3·08	10·021
Water	4·00	14·380
	and loss	a trace of oxide of iron.

3. Alum-stone is found at Tolfa near Civita Vecchia, in the vicinity of Rome; also in Tuscany in the kingdom of Naples, and in the county of Beregh in Hungary. According to Cordier, it exists in almost all burning volcanoes. It seems to form beds of greater or less extent, chiefly made up of the massive varieties, in which small cavities occasionally present themselves lined with the crystals, which are always very minute.

4. It is employed in the manufacture of alum; and the superior quality of that from Tolfa has been ascribed to this mineral.

Amalgam. (See *Native Amalgam.*)

Amazon stone. (See *Feldspar.*)

Amausite. (See *Petrosilex.*)

AMBER. Yellow Mineral-Resin. Mohs.

Irregular forms, grains and spheroidal masses.

Amber.

Cleavage none. Fracture conchoidal. Surface uneven and rough.

Lustre resinous. Prevalent color yellow, passing into red, brown and white. Streak white. Transparent... translucent.

Not very brittle. Hardness = 2·0...2·5. Sp. gr. = 1·081.

Resinous electricity produced by friction.

1. Two sub-species have been distinguished in Amber, according to their lustre and transparency. *Yellow* Amber contains yellow and red varieties, and which possess the highest degrees of transparency to be met with in the species. *White* Amber refers to white and pale yellow, faintly translucent varieties. Often, however, both kinds are joined in one and the same specimens,—passing insensibly into each other, which demonstrates their identity.

2. Amber burns with a yellow flame, giving out an agreeable odor, and leaves a carbonaceous residue. It is soluble in alcohol.

3. *Analysis.*

By Drappier.

Carbon	80·59
Hydrogen	7·31
Oxygen	6·73
Lime	1·54
Alumina	1·10
Silica	0·63

4. Amber, without doubt owes its origin to the vegetable kingdom; an opinion sufficiently established by the insects and other organic bodies which it often includes, by the analogous substance known in commerce under the name of Gum Copal, which is afforded by a family of trees growing in India, as well as by the circumstances under which Amber is known to occur,—it being found in beds of bituminous wood, from which it is disengaged by the action of the waves on the sea coast.

5. The principal places from whence Amber is obtained are: the Prussian borders of the Baltic Sea, (where it is collected by the government, either during or immediately after storms, which rake it up from its bed and throw it on shore,) Denmark, Spain, Sicily, Greenland, Chi-

na and other countries. It has repeatedly been met with in various parts of the Green sand formation of the United States, either loose in the soil, or engaged in marl or lignite, as at Gay Head on Martha's Vineyard, near Trenton in New Jersey, at Camden in Pennsylvania, and at Cape Sable (near Magothy river) in Maryland.

6. The more transparent and handsomely colored specimens are cut into various ornaments and works of art; more common varieties are employed in the formation of certain kinds of varnish. It is also used for fumigation. The oil and acid of amber were formerly articles of medicine.

AMBLYGONITE. Prismatoidal Petaline-Spar.

Primary form. Oblique rhombic prism. M on M′ = 106° 10′.

Cleavage parallel to the prismatic faces, apparently with greater facility in one direction than in the other. Fracture uneven.

Lustre vitreous, inclining to pearly. Color greenish-white, passing into light mountain and celandine-green. Streak white. Semi-transparent . . . translucent.

Hardness = 6·0. Sp. gr. = 3·00 . . . 3·04.

Compound Varieties. Massive: composition columnar.

1. Heated by itself in a matrass, it affords a little moisture, which in a high heat is perceptibly acid, and corrodes the glass. Upon charcoal, before the blow-pipe, it easily melts into a clear glass, which however becomes opake on being suffered to cool.

2. *Analysis.*

By Berzelius.

Phosphoric acid	54·12
Alumina	38·96
Yttria	6 92

3. It is found only at Chursdorf near Penig in Saxony, where it occurs in granite along with Tourmaline and Topaz.

Amethyst. (See *Quartz.*)

AMIANTHUS.

Silky fibrous varieties of *Hornblende*, *Pyroxene*, *Picrosmene* and *Nemolite*. q. v.

AMPHIBOLE. (See *Hornblende*.)

AMPHIGE'NE. (See *Leucite*.)

AMPHODELLITE.

Crystalline; the form of the crystals said to resemble those of Feldspar. Cleaves in two directions, whose mutual inclination is 94° 9′.

Fracture resembles that of Scapolite. Color reddish.

Hardness = 4·5. Sp. gr. = 2·793.

1. *Analysis.*

By NORDENSKÖLD.

Silica	45·80
Alumina	35·45
Lime	10·15
Magnesia	5·05
Protoxide of iron	1·70
Moisture and loss . . .	1·85

2. It is found in the lime quarries of Lozo in Finland.

3. There does not appear to be any sufficient reason why Amphodellite should not be included under Scapolite, except the indications of crystalline form, which however do not appear to have received much attention.

ANALCIME. Hexahedral Kouphone-Spar. MOHS.

Primary form. Cube.

Secondary forms.

Fig. 6.

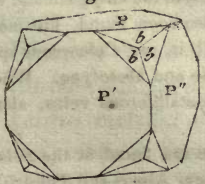
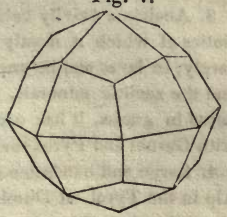


Fig. 7.



P, P′ or P″ on *b*	- - - -	144°	44′	8″
b on *b*	- - - -	146	26	33

Analcime.

Cleavage parallel with the primary form obtained with difficulty; and even when most distinct, of a very interrupted appearance.

Fracture, imperfectly conchoidal, uneven.

Surface in general smooth, sometimes faintly streaked.

Lustre vitreous. Color white, passing into grey, more frequently into reddish-white and flesh-red. Streak white transparent . . . translucent.

Brittle. Hardness = 5·5. Sp. gr. = 2·068 (crystals from the Tyrol.)

Compound Varieties. Massive: composition granular, of various sizes of individuals, more or less strongly coherent. Faces of composition uneven and rough, and often irregularly streaked.

1. When first heated, Analcime becomes milk-white, and affords a little moisture: in a more intense heat upon charcoal, it melts without intumescence or ebullition into a clear, slightly vesicular, glassy globule. It gelatinizes in muriatic acid.

2. *Analysis.*
By Berzelius.

Silica	55·84
Alumina	22·55
Soda	13·73
Water	7·90

3. Analcime chiefly belongs to trap and basalt, in the amygdaloidal varieties of which it mostly abounds. It has also been found, but more rarely, in lavas and in gneiss. Associated with it, are Calcareous spar and the zeolitic minerals, particularly Chabasie and Mesotype. When found in gneiss, it has occurred in beds, or metalliferous veins, along with Garnet and Pyroxene.

4. Large and handsome crystals of Analcime are found at the Seiser Alp in the Tyrol, at Dumbarton in Scotland, near Almas and Tökörö in Transylvania. Other localities are, the western isles of Scotland, Faroe Islands and Iceland, Partridge Island in the Basin of Mines, (Nova Sco-

Anatase.

tia,) and Monte Somma—where from its being of a flesh-red color it has received the name of *Sarcolite*. It is met with in the iron-stone beds of Arendal in Norway, and in the silver veins of Andreasberg in the Hartz.

ANATASE. Pyramidal Titanium-Ore. Mohs.

Primary form. Octahedron with a square base. P on P (over the base) $=136° 47'$.

Secondary forms.

Fig. 8.

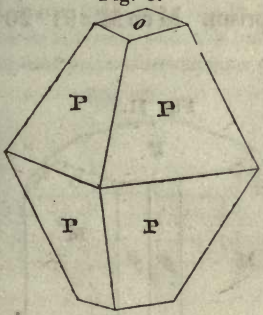
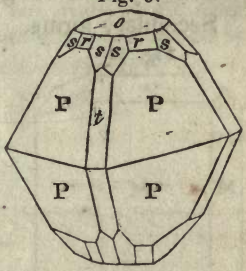


Fig. 9.



P on *o*	-	-	-	-	111°	17′
r on *o*	-	-	-	-	152	27
r on *s*	-	-	-	-	166	30
P on *s*	-	-	-	-	132	5

Cleavage parallel to the primary faces and to *o*, both perfect.

Fracture conchoidal, scarcely observable.

Surface smooth and shining.

Lustre metallic adamantine. Color various shades of brown, more or less dark, also indigo-blue. Streak white. Semi-transparent . . . translucent.

Hardness $= 5{\cdot}5 \ldots 6{\cdot}0$. Sp. gr. $= 3{\cdot}826$.

1. Before the blow-pipe, it behaves like pure oxide of titanium. It dissolves, with difficulty, in the salt of phosphorus, and the portion not melted becomes white and semi-transparent. The experiments of VAUQUELIN prove it to be a pure oxide of titanium.

2. It occurs in narrow, irregular veins, consisting of those species which constitute the rocks themselves, viz. Albite, Quartz, Mica and Augite, and is sometimes accompanied by Axinite and Crichtonite.

Its chief localities are Bourg d'Osians, in Dauphiny and Switzerland; but it is also found in Cornwall, in Norway, in Spain and Brazil.

ANDALUSITE. Prismatic Andalusite. MOHS.

Primary form. Right rhombic prism. M on M′ = 91° 20′

Secondary forms.

Fig. 10.

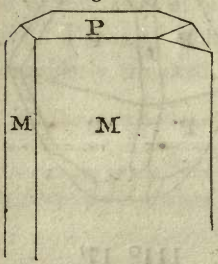
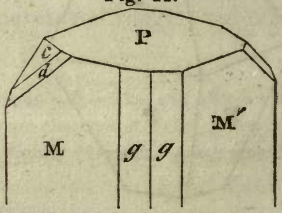


Fig. 11.



M on M′	-	-	-	91°	20′
P on M′ or M	-	-	-	90	00
P on *c*	-	-	-	140	00
d on *c*	-	-	-	145	00
g on *g*	-	-	-	125	00

Cleavage, parallel with M and M′ distinct; parallel with P scarcely perceptible.

Fracture uneven.

Surface uneven and rough. Generally covered with plates of Mica or Talc.

Lustre vitreous. Color flesh-red passing into pearl-grey. Streak white. Translucent on the edges.

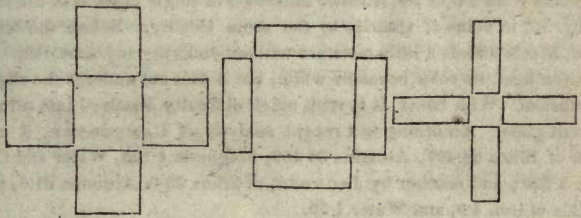
Andalusite.

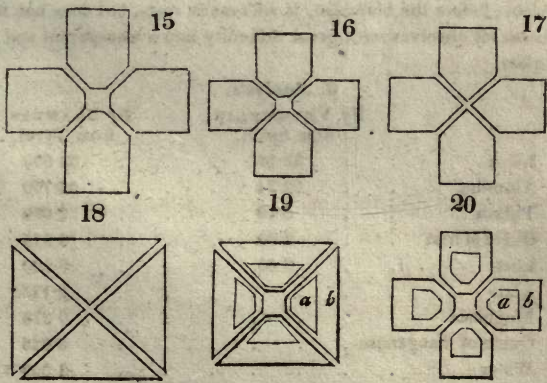
Hardness = 7·5. Sp. gr. = 3·104 (of a cleavable variety.)

Compound varieties. Massive : composition indistinctly granular and columnar.

1. The mineral long known under the name of *Macle* or *Chiastolite* appears to be a mixed mineral, consisting of Andalusite and some of the minerals entering into the formation of clay slate ; the Andalusite assuming a crystalline form and being subject to a remarkable composition, which will be understood from the annexed figures representing cross sections of the twin-crystals. The twin crystal in each instance, it will be seen, results from the juxta-position of four single crystals, whose nearest point of contact, as respects any two of them, is formed by

Fig. 12. Fig. 13. Fig. 14.





their lateral edges. It is not common to find the edges of the bases equal, as in fig. 12; two of the sides being more frequently unduly extended, as in figs. 13 and 14. Cross-sections made in different parts of one crystal sometimes afford the different appearances of figs. 12, 13, and 14. But the more common mode of aggregation is represented by figs. 15, 16, 17 and 18, which results from the greater or less replacement of the angles that are adjacent in the composition. Rarely, we are presented with a parti-colored aspect, as in figs. 19 and 20, the inner portion *a* exhibiting a milk-white color, while the exterior *b*, is of a greenish grey color. The hardness of these crystals varies from 3·0 to 7·5, according to the preponderance of Andalusite in their composition. Those which possess the hardness of 7·5 have the color, lustre and cleavages of Andalusite. The circumstance which determines to the formation of these twin-crystals pertains apparently to the gangue; for the Macle occurs only in clay slate, while a similar aggregate, varying in hardness from 3·0 to 7·5, is found imbedded in single crystals of the form of fig. 12, in veins of Quartz, at the same locality. Before the blowpipe, Macle affords a little moisture without suffering any alteration. In a white heat, its color becomes white, but it does not undergo the slightest fusion. With borax, it is with much difficulty dissolved into a transparent glass. According to a recent analysis of LANDGREBE, it consists of Silica 68·497, Alumina 30·109, Magnesia 1·125, Water and Carbon 0·269; and another by JACKSON, of Silica 33·0, Alumina 61.0, protoxide of iron 4·0, and Water 1·50.

2. Alone, before the blowpipe, it whitens in spots, but does not melt. With borax, it dissolves with great difficulty into a transparent and colorless glass.

3. *Analysis.*

	By VAUQUELIN, from Spain.	By BRANDES, from Tyrol.
Silica	32·16	34·000
Alumina	52·24	55·750
Potash	8·10	2·000
Oxide of iron	2·00	3·375
Loss	6·00	0·000
Lime		2·125
Magnesia		0·375
Oxide of manganese		3·625
Water		1·000

4. Crystals of Andalusite are found imbedded in mica slate, or implanted in the cavities of rocks forming irregular beds or nodules in gra-

nite and primitive slate. It is generally associated with Quartz, sometimes with a decomposing Mica.

5. This species was first discovered in the province of Andalusia in Spain. Crystals of very considerable magnitude are found in the valley of Lisenz near Inspruck in the Tyrol. It also occurs near Braunsdorf in Saxony, at Herzogau in the Upper Palatine, at Forez in France, in grey dolomite containing Hornblende in the Simplon, and in black limestone with granular Iron-Pyrites at Coulepeux in the valley of Ger, (Haut Garonne,) in mica-slate in Aberdeenshire in Scotland, in the counties of Wicklow and Dublin in Ireland. In the United States at Westford, Mass. it occurs abundantly both crystallized and massive. A few handsome crystals have also been found at Litchfield, (Con.)

6. The Chiastolite or Macle is found at a great number of places; but no where so plentifully, or under such a diversity of forms, as in the towns of Lancaster and Sterling, (Mass.) It is in Lancaster that the single crystals of Macle imbedded in Quartz have been found, and which occur under the common form of Andalusite. Foreign localities of Chiastolite are the following: St. Jago di Compostella in Spain, Barèges in the Pyrenees, the Bayreuth, Hartz, and Cumberland in England.

ANDREOLITE. (See *Harmotome.*)

ANGLARITE. (See *Vivianite.*)

ANGLESITE. Prismatic Lead-Baryte. Mohs.

Primary form. Right rhombic prism. M on M′ = 103° 42′.

Secondary forms.

Fig. 21.

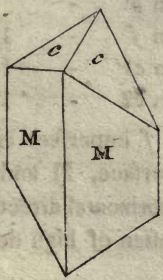
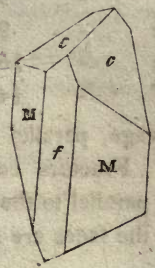


Fig. 22.



Anglesite.

Fig. 23.

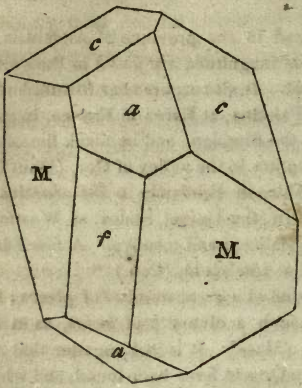


Fig. 24.

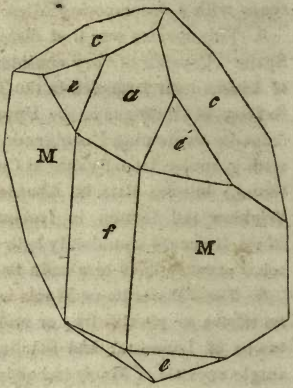
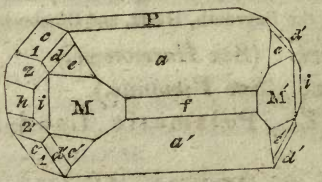


Fig. 25.



M on M′	-	103°	47′	M on *h*	-	128°	10′
P on *a*	-	140	36	M on *c*1	-	127	56
P on *e*	-	115	40	M on *i*	-	160	42
P on *f*	-	90	00	*a* on *a*′	-	79	30
P on *h*	-	90	00	*a* on *f*	-	129	28
M on *c*	-	153	20	*c*1 on *c*1′	-	104	30
M on *f*	-	141	52	*c*1 on *c*2	-	142	20

Cleavage, parallel with M and *f* imperfect and interrupted. Fracture conchoidal. Surface, M and *f* often striated parallel to the axis, *a* in a horizontal direction. In general the faces are smooth, and often of high degrees of lustre.

Lustre adamantine, inclining to vitreous and resinous. Color yellowish, greyish, or greenish white, also yellowish, smoke and ash-grey. Sometimes faintly tinged green or blue. Streak white. Transparent... translucent.

Brittle. Hardness = 2·5 ... 3·0. Sp. gr. = 6·298.

Compound Varieties. Massive: composition lamellar, also granular, of various sizes of individuals, often strongly connected. Faces of composition rough.

1. It decrepitates in the flame of a candle, and frequently assumes a slight reddish tinge on the surface. Reduced to powder it melts easily before the blow-pipe into a white slag, which is reduced to metallic lead by the addition of soda.

2. *Analysis.*

By STROMEYER.

Oxide of lead . . .	72·47
Sulphuric acid . . .	26·09
Water . . .	0·12
Hydrous oxide of iron . . .	0·09
Oxide of manganese . . .	0·06
Silica . . .	0·51

3. It is found in lead and copper veins, traversing clay-slate and greywacke slate, along with various ores of lead and copper.

4. It is found at the Lead hills and Wanlockhead in Scotland, Pary's mine in Anglesea, Mellanoweth in Cornwall; also at Clausthal and Zellerfeld in the Hartz, near Freiberg in Baden, at Siegen in Prussia, in Spain, and Siberia.

It occurs along with Galena in the lead mines of Missouri: also in the lead mine of Southampton, (Mass.)

ANHYDRITE. Prismatic Gypsum-Haloide. MOHS.

Primary form. Right rectangular Prism.

Anhydrite.

Secondary form.

Fig. 26.

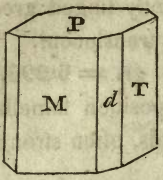
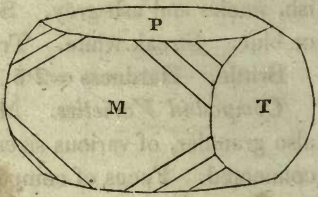


Fig. 27.



P on M, or T	-	-	90°	0′
M on T	-	-	90	0
M on *d*	-	-	140	4
T on *d*	-	-	129	56

Cleavage parallel with M and T perfect; less easily obtained parallel with P, yet quite distinct.

Fracture imperfectly conchoidal, uneven. Surfaces M and T smooth; P rough.

Lustre vitreous, inclining a little upon the most distinct faces of cleavage to pearly. Color generally white, sometimes passing to flesh-red, violet-and smalt-blue or ash-grey. Streak greyish-white. Transparent . . . translucent.

Brittle. Hardness = 3·0 . . . 3·5. Sp. gr. = 2·89.

Compound Varieties. Contorted; composition columnar in thin fibres, parallel and variously bent. Massive: composition granular, of different sizes, sometimes impalpable, and then the fracture is splintery; in other massive varieties, the composition is columnar, commonly thin and parallel. Faces of composition rough.

1. This species has been divided into several subspecies in the earlier treatises on mineralogy. Thus the *Cubic Muriacite*, also called Cube spar, comprehends simple varieties, and easily cleavable compound ones, in which the individuals possess a considerable size. The name *Anhydrite* was appropriated to varieties of a smaller granular composition, and

that of *Tripe stone* (*Gekrösstein*) to the contorted compositions, consisting of thin columnar individuals. *Compact* and *fibrous* Muriacite were the denominations of compound varieties of very small individuals, the one granular and impalpable, the other columnar. The *Vulpinite* of Italy, so named from its locality, is composed of granular individuals, a little longer in one direction, of a greyish white or grey color, and very much resembling a coarse grained, primitive marble.

2. When heated alone in a matrass, it yields no moisture. Before the blow-pipe in platina forceps, it is converted, with difficulty, into a white enamel, the heated mass affording when moistened an alkaline reaction. With borax, it dissolves, accompanied by effervescence, into a transparent glass, which on cooling assumes a yellow or brownish yellow color.

3. *Analysis.*

By KLAPROTH,
a cleavable variety from Hall in the Tyrol.

Sulphuric acid	55·00
Lime	41·75
Muriate of soda	1·00

Except the muriate of soda, the other varieties which have been analyzed, have presented nearly the same proportions.

By a peculiar process, which is natural, Anhydrite attracts water, loses its transparency, becomes diminished in hardness and specific gravity and approaches in these properties common Gypsum. The cleavage of this altered substance still enables us to distinguish it from Gypsum. It has been called *Chaux sulfatée épigène* by HAUY.

4. Anhydrite is found in beds of gypsum, and of clay along with common salt. It also occurs with metallic minerals, as Galena and Blende.

5. Splendid geodes of large and well defined crystals (fig. 11.) of Anhydrite have been found at Aussee in Stiria; other crystallized varieties at Hall in the Tyrol, at Hallein in Salzburg, in Switzerland, &c. The blue variety is found at Sulz on the Neckar, and at Bleiberg in Carinthia. Foliated Anhydrite, transparent and of a fine blue color, is frequently met with in geodes in the black limestone at Lockport, (N.Y.) associated with crystals of Calcareous spar and Gypsum. Columnar varieties occur at Ischel and Berchtesgaden; compact ones, in the Hartz, in Mansfeld, &c.; the contorted varieties are found at Wieliczka and Bochnia in Poland. The decomposed Anhydrite occurs in considerable quantities at Aussee in Stiria, at Bex in Switzerland, and in other places. It is observed at Lockport in thin coatings upon the foliated variety above alluded to, and also filling up crevices among the foliæ.

6. The blue varieties, in which the granular particles of composition cohere more firmly than in others, are cut and polished for various ornamental purposes, and are known in the arts by the name of *Marmo bardiglio di Bergamo.*

Anhydrous Silicate of Iron.

Massive: foliated.

Cleavage, divides easily into four-sided prisms.

Color dark brown, opake.

Hardness = 4. Sp. gr. = 3·884.

Brittle. Attracted by the magnet.

1. Heated in a glass-tube, it emits ammoniacal vapors, and loses 1·97 of its weight. Alone before the blow-pipe, it is infusible, but in the reducing flame acquires a metallic lustre, and assumes the appearance of magnetic iron. Dissolves in muriatic acid by the aid of heat, without effervescing, leaving behind a quantity of silica in flakes.

2. *Analysis.*

By Thomson.

Silica	29·600
Protoxide of iron . . .	68·605
Protoxide of manganese . .	1·857

3. It is found at Sclavcorrach, one of the Morne mountains, in the north-east of Ireland.

4. Not enough is known concerning the foregoing mineral to pronounce upon its specific character with certainty. It scarcely differs from Yenite except in being attracted by the magnet, and in its infusibility.

ANKERITE. Paratomous Lime-Haloide. Mohs.

Primary form. Rhomboid. P on P = 106° 12′.

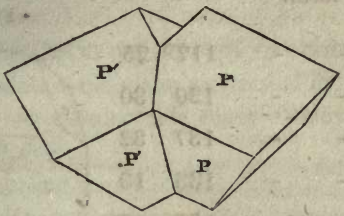
Cleavage parallel with the primary faces perfect. Fracture uneven.

Lustre vitreous, slightly inclining to pearly. Color white, with various tints of grey, red and brown. Streak brown, Translucent, often very faintly.

Brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 3·080.

Compound Varieties. Twin-crystals. Face of composition parallel with the vertical axes.

Fig. 28.



Massive: composition granular, individuals in most cases easily discernible, often mixed with Calcareous Spar. Faces of composition uneven and rough.

1. It becomes black before the blow-pipe without melting, and acts upon the magnetic needle. With borax it melts into a pearl. The color is darkened on the surface by being exposed to the air.

2. *Analysis.*

By SCHRÖTTER.

Carbonic acid with oxide of iron	35·308
Lime	50·113
Magnesia	11·846
Oxide of manganese . . .	3·084

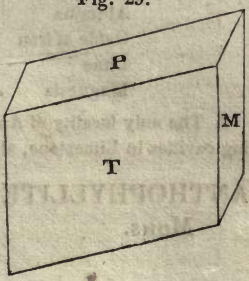
3. The Ankerite occurs in the Rathhausberg in Salzburg upon beds in mica-slate, and in many places upon the beds of Heavy Spar, extending from Stiria along the whole chain of the Alps. The Ankerite forms veins in the transition limestone about the city of Quebec, and in the U. States it occurs in connexion with the coal formation at West Springfield, (Mass.)

ANORTHITE. Anorthotomous Feldspar.

PARTSCH.

Primary form. Doubly oblique prism.

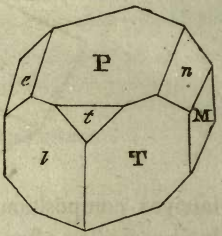
Fig. 29.



M on P	-	94°	12′
M on T	-	117	28
P on T	-	110	57

Secondary form.

Fig. 30.



M on *l*	-	-	117°	25′
T on *l*	-	-	120	30
P on *e*	-	-	137	32
P on *n*	-	-	133	13
P on *t*	-	-	138	46

Cleavage, parallel to P and M; none parallel to T.

Fracture conchoidal.

Surface of T more smooth than of *l*.

Lustre pearly upon cleavage planes, vitreous in other directions. Color white. Streak white. Transparent... translucent.

Brittle. Hardness = 6·0. Sp. gr. = 2·763 (massive); = 2·656 (small crystals, apparently not entirely free from Augite.)

1. Before the blow-pipe it behaves like Feldspar, except that with soda it does not give a clear glass. It is entirely decomposed by concentrated muriatic acid.

2. *Analysis.*
By Rose.

Silica	44·49
Alumina	34·46
Oxide of iron	0·74
Lime	15·68
Magnesia	5·26

3. The only locality of Anorthite is Mount Vesuvius. It is found lining cavities in Limestone, along with a green variety of Augite.

ANTHOPHYLLITE. Prismatic Schiller-Spar. Mohs.

Anthophyllite.

Primary form. Oblique rhombic prism. P on P′= 125°.

Cleavage parallel to the sides of the primary form and both its diagonals,—the cleavage parallel to the longer diagonal being more distinct and easily obtained.

Fracture uneven.

Surface streaked parallel to the axis.

Lustre pearly, inclining to metallic, particularly upon the perfect face of cleavage. Color between yellowish-grey and clove-brown. Streak white. Translucent, sometimes, only on the edges.

Brittle. Hardness=5·0 . . . 5·5. Sp. gr.=3·129.

Compound Varieties. Massive; composition columnar, straight, sometimes divergent and rather broad; faces of composition irregularly streaked. They are often aggregated in a second composition, which is angulo-granular and wedge-shaped.

1. Alone before the blow-pipe, it is unalterable except in very thin fragments, when it fuses on the edges into a black slag. With borax, it melts with difficulty into a glass, colored by iron.

2. *Analysis.*

	By John.	By Thomson.	By Gmelin.
Silica	56·00	56·290	56·00
Alumina	13·30	1·545	3·00
Magnesia	14·00	19·665	23·00
Lime	3·33	0·000	2·00
Oxide of iron	6·00	7·280	0·00
Oxide of manganese	3·00	0·000	4·00
Water	1·43	1·685	0·00
Potash	0·00	13·500	12·00

3. Anthophyllite occurs in beds of mica-slate, accompanied by Garnet, Talc, Augite, Iolite, &c.

4. It has been brought from the cobalt and copper mines of Kongsberg and Modum in Norway. It is found with Augite in Greenland; and

with Tourmaline and Iolite at Haddam, (Con.) It also occurs with Quartz in mica-slate, at Chesterfield and Blandford, (Mass.)

ANTHRACITE. Non-Bituminous Mineral-Coal. Mohs.

No regular form or structure. Massive, generally impalpable; rarely vesicular, and sometimes divided into columnar masses, meeting in rough faces.

Fracture conchoidal, often perfect.

Lustre imperfect metallic. Color iron-black, sometimes inclining to greyish black, often beautifully tarnished. Streak unchanged. Opake.

Not very brittle. Hardness = 2·0...2·5. Sp. gr. = 1·4.

1. The *Columnar Glance-Coal* of Jameson, and the *Mineral Carbon*, or *Mineral Charcoal*, are both varieties of Anthracite. The former is remarkable for its irregular columnar composition, which is probably produced by fissures, and the low degree of lustre in its fracture: the latter occurs in thin layers and massive specimens of a very delicate columnar composition, and presenting a silky lustre.

2. The varieties of the present species do not contain any bitumen, but consist wholly of carbon, occasionally mixed with a small proportion of oxide of iron, silica and alumina. They are inflamed with difficulty, and burn without smoke or bituminous smell and with little or no flame,—leaving a more or less considerable earthy residue.

3. Anthracite is found occasionally in more ancient rocks; but its principal deposits are in secondary strata, consisting of coarse sand stones, greywacke and slate. It is sometimes met with in veins traversing trap rocks.

4. Vast deposits of Anthracite are found in the United States. The most celebrated of these is the anthracite region, so called, of the Susquehanna, situated chiefly in Luzerne county, (Pen.) It is between sixty and seventy miles long, and about five broad, constituting a trough or elongated basin, through which the Susquehanna river and Lackawanna creek, flow. The Anthracite breaks out throughout this region in precipices and hills, forming in some places the beds of the rivers and

smaller streams which descend from the mountains; and the whole of this extent is completely overlaid by coal beds of various thicknesses, repeated again and again with their attendant rocks. The neighboring counties of Schuylkill and Lehigh abound in this species also, where it occurs under similar circumstances. The Anthracite of Pennsylvania is distinguished by its sub-slaty and conchoidal fracture. Very frequently also, it is liable to the most splendid tarnishes which this species ever presents. A second Anthracite region is Rhode Island, where a formation exists at Portsmouth; and a third in Worcester, (Mass.) The Anthracite of these last mentioned districts is remarkable for its irregular columnar composition, dull grey color, and low degree of lustre. This last variety is found on the Meissner in Hessia, forming the uppermost division of a bed of bituminous wood, covered by basalt. It also occurs in Scotland. The slaty Anthracite is found at Schönfield in Saxony, in Savoy, at Kongsberg in Norway, at Staffordshire in England, in Ayrshire Scotland, and at Kilkenny in Ireland.

5. On account of the difficult inflammability of this species of coal, and its scarcity in Europe, it appears to have attracted little attention for economical purposes. Its abundance in this country however, and the cheapness with which it is raised, (it being worked in open quarries,) have brought it into extensive use. At present, it forms the principal fuel in the maritime cities of the northern states, and is applied to nearly every purpose of raising temperature.

ANTHRAKONITE.

An impure Calcareous Spar, which owes its prismatic concretionary form to some species of *Favosites*.

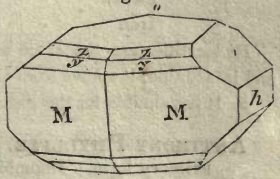
ANTIMONIAL SILVER. Prismatic Antimony.

MOHS.

Primary form. Right rhombic prism?

Secondary form.

Fig. 31.



M on M - - - 120° 0′

Antimonial Silver.

Cleavage parallel to *o* and P distinct; cleavage parallel to M imperfect.

Fracture uneven.

Surface in general smooth.

Lustre metallic. Color silver-white, inclining to tin-white. Streak unchanged.

Hardness = 3·5. Sp. gr. = 9·44 . . . 9·8.

Compound Varieties. Twin-crystals like those of Arragonite and White Lead-Ore. Massive: composition granular, individuals of various sizes, and easily separated.

Pseudomorphic six-sided prisms.

1. Before the blow-pipe, it yields a globule of silver, while the antimony is driven off.

2. *Analysis.*

Silver	76·5
Antimony	23·5

3. It is found accompanied by Native Silver, Native Arsenic, Galena and various other species. Its localities are Altwolfach in Fürstenberg, and Andreasberg in the Hartz.

4. The *Arsenical Silver* is considered as a more or less intimate mechanical mixture of Native Arsenic, or of Mispickel with Antimonial Silver. It possesses the color of Native Silver, but is commonly tarnished externally of a blackish color. It occurs in small, curved lamellar compositions, consisting of very thin crystalline coats. It is harder than Antimonial Silver. Before the blow-pipe, the arsenic and antimony are for the most part volatilized, leaving a globule of impure silver, surrounded by a slag. A specimen from Andreasberg afforded Klaproth,

Arsenic	35·00
Antimony	4·00
Silver	12·75
Iron	44·25

Its localities are the same as those mentioned for Antimonial Silver, and in addition, it comes from Guadalcaual in Estremadura in Spain.

5. It is valuable for the extraction of silver.

Antimony Phyllite.

Primary form. Rhombic prism. Dimensions unknown, and likewise whether the prism be right or oblique.

Apatite.

Secondary form. A thin, six-sided prism derived from a rhombic prism, through the truncation of the acute edges.

Cleavage parallel with the lateral planes of the primary form, and with its shorter diagonal.

Fracture scarcely observable.

Surface uneven.

Lustre pearly, inclining to adamantine. Color greyish-white. Translucent.

Sectile. Thin laminæ are flexible, like Talc.

Hardness = 1·0 . . . 1·5. Sp. gr. = 4·025.

1. Before the blow-pipe, it conducts like white Antimony. A copious precipitate of oxide of antimony is thrown down from its solution in muriatic acid, by water.

2. But two specimens of this mineral, the one at Dresden and the other at Halle, have been seen; and their locality is unknown.

APATITE. Rhombohedral Fluor-Haloide.

MOHS.

Primary form. Regular hexagonal prism.

Secondary forms.

Fig. 32.

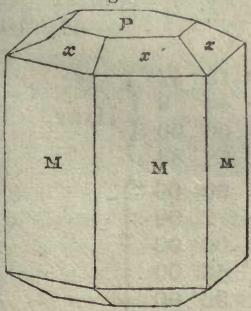
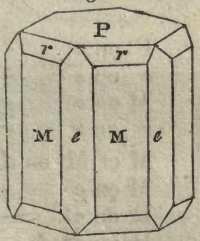


Fig. 33.



M on x	-	-	129°	13′	53″	HAUY.
P on x	-	-	140	46	7	
x on x	-	-	143	7	48	
M on e	-	-	150	00	00	HAUY.
M on r	-	-	112	12	28	
P on r	-	-	157	47	32	

Apatite.

Fig. 34.

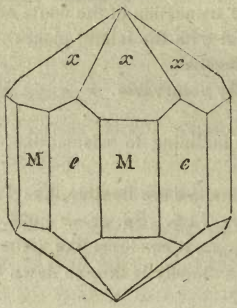


Fig. 35.

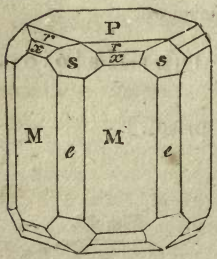
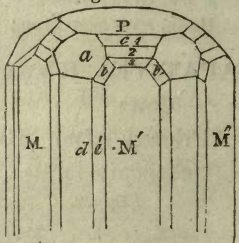


Fig. 36.



P on *s*	- -	125°	15′	52″	} Hauy.
e on *s*	- -	144	44	8	
M on *s*	- -	135	00	00	
r on *x*	- -	162	58	33	
M or M′ on *d*	-	150	00	00	} Phillips.
M on *e*	- -	169	2	00	
P on *c*1	- -	157	00	00	
P on *c*2	- -	134	43	00	
P on *c*3	- -	120	38	00	
P on *a*	- -	124	16	00	
M on *c*1	- -	112	48	00	
M on *c*2	- -	130	30	00	
M on *c*3	- -	139	48	00	
M′ on *b* or *b′*	-	149	40	00	
b on *a*	- -	162	18	00	

The planes *bb* are rarely seen together on the same crystal.

Apatite.

Cleavage parallel with the planes of the primary form, that parallel with the base obtained with most difficulty.

Fracture conchoidal, more or less perfect, uneven.

Surface, the secondary faces generally very smooth; the primary lateral ones striated in a longitudinal direction. Sometimes all the edges are rounded.

Lustre vitreous, inclining to resinous. Color white, frequently violet-blue, mountain-green, or asparagus green; also yellow, grey red and brown colors, though none of them are bright. Transparent or translucent. A bluish opalescence appears upon the faces parallel to the principal axis in some crystals, particularly the white varieties.

Brittle. Hardness = 5·0. Sp. gr. = 3·225 (asparagus-green crystals from Spain); = 3·180, from Salzburg.

Compound Varieties. Implanted globular and reniform shapes: composition imperfectly columnar; faces of composition rough. Massive: composition granular, individuals of different size, not impalpable; faces of composition uneven or rough.

1. Several varieties of the present species which are decidedly separate from others and connected among themselves, were formerly considered as forming two or even three distinct species. The distinctive marks between them, however, are so slight, that they are incapable of being indicated with certainty, and it would therefore be superfluous to attempt their explanation.

2. Certain varieties are phosphorescent upon ignited charcoal and before the blow-pipe; in particular those crystals which are terminated by a single plane, some of which phosphoresce when rubbed with hard bodies. In a very strong heat of the blow-pipe, the edges and solid angles are rounded off; but it does not melt without addition. With borax, it dissolves slowly into a clear glass. With salt of phosphorus it dissolves in great quantities, affording a transparent glass, which, when nearly saturated, becomes opake in cooling, and presents crystalline faces, similar, but less distinct than phosphate of lead. Apatite has been artificial-

ly formed by exposing a mixture of phosphoric acid and sulphate of lime to a high temperature. It exhibits a lamellar texture, and shows by heat on opposite ends, opposite kinds of electricity,—a property not hitherto observed in the natural crystals of Apatite.

3. *Analysis.*

	By Klaproth.	By Vauquelin, from Spain.	By Pelletier & Donadei, fr. Spain.
Lime	55·0	54·28	59·0
Phosphoric acid	45·0	45·72	34·0
Carbonic acid	.	.	1·0
Muriatic acid	.	.	0·5
Fluoric acid	.	.	2·5
Silica	.	.	2·0
Iron	.	.	1·0

4. There are examples of Apatite entering as an occasional admixture into the composition of rocks, as granite and limestone. But it more frequently appears in beds and veins, consisting chiefly of ores of iron and tin, or of crystallized varieties of those species of which the rocks themselves are composed. The crystallized variety, called *Asparagus-stone* from Spain, is found in an ancient volcanic rock, along with Specular Iron and compact Calcareous-spar. The compound varieties, called *Phosphorite*, of the same country, form particular beds.

5. Ehrenfriedersdorf in Saxony, Schlackenwald in Bohemia, the Greiner mountain in Salzburg, Cabo de Gata in Spain, Devonshire and Cornwall, are some of the most distinguished localities of this species. Arendal in Norway affords the bluish green and reddish brown crystals, (*Moroxite*); St. Gothard in Switzerland, and Heiligenbluter Tauern in Salzburg, furnish remarkable white, transparent crystals; and Estremadura in Spain, and Schlackenwalk in Bohemia, produce massive varieties, while a pulverulent variety is found at Marmarosch in Hungary. Small yellow crystals occur at Partridge Island in Nova Scotia.

Apatite has been found in many places in the United States; but we possess but one locality which affords it in any considerable quantity, or in well crystallized specimens, and this is at Governeur, St. Lawrence Co. (N.Y.) where it occurs crystallized in granular limestone, the crystals being very abundant, large, (sometimes 4 or 6 inches in length,) well defined, having the form of fig. 35, (except *r*,) and possessing a rich sea-green or mountain-green color. Crystals several inches long, of the primary form have been obtained at Amity, (N.Y.) where it occurs of a green

color in white limestone, associated with brown Augite and Scapolite. At Bolton, (Mass.) it occurs crystallized and massive, of a bluish green color, under similar circumstances, with the addition of Petalite and Sphene. Handsome green crystals have been found at Monroe, (Con.) in granite: but they are scarce. Very distinct crystals an inch or more in length, of a reddish brown color, are occasionally met with in a vein of granite at Greenfield, (N.Y.) acccompanied by Chrysoberyl, Tourmaline and Garnet. The following localities of Apatite in small green or yellowish green crystals, imbedded in granite, are quoted in Cleaveland's Mineralogy, viz., near Baltimore, (Maryland,) near Wilmington, (Delaware,) near Philadelphia, New York and New Haven; also the following in Iron Pyrites:—near Green Pond, Morris co. (N.Y.) and at Anthony's Nose in the Highlands of New York.

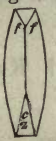
APHANESITE. Aphanistic Copper-Baryte.

Primary form. Oblique rhombic prism. M on M′ = 56°. P on M = 99° 30′.

Secondary forms.

Fig. 37.

Fig. 38.



P on *a*1	- -	125°	00′
P on *c*1	- -	80	30
P on *c*2	- -	99	30
f on *f*	- -	62	30

Lustre pearly upon the face of perfect cleavage. Color dark verdigris-green, inclining to sky-blue, still darker on the surface. Streak verdigris green. Translucent on the edges.

Not very brittle. Hardness = 2·5 . . . 3·0. Sp. gr. = 4·192.

1. Before the blow-pipe it deflagrates and emits arsenical vapors.

2. *Analysis.*
By Chenevix.

Oxide of copper . . .	54·00
Arsenic acid . . .	30·00
Water . . .	16·00

3. It has hitherto been found only in Cornwall, with several other species of the salts of copper, and with Copper Pyrites and Quartz.

APHRITE. (See *Calcareous-Spar.*)

APLOME. (See *Garnet.*)

APHTHITALITE. Prismatoidal Glauber-Salt.

Massive;* mammillary, apparently formed in successive layers.

Lustre vitreous. Color white, with certain bluish or greenish stains. Translucent.

Rather brittle. Hardness = 2·5...3·0. Sp. gr. = 1·731.

Taste saline and bitter, disagreeable.

1. It has not been analyzed, but probably will be found to be a sulphate of potash, with a trace of sulphate and muriate of copper.

2. It occurs at Mount Vesuvius.

APOPHYLLITE. Pyramidal Kouphone-Spar. MOHS.

Primary form. Right square prism.

* The artificial crystals are right rhombic prisms of 112° 8′, having their acute angles replaced so as to form dihedral summits of 106° 46′, and having the lateral edges truncated.

Apophyllite.

Secondary forms.

Fig. 39.

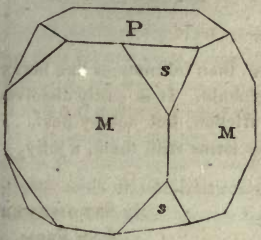


Fig. 40.

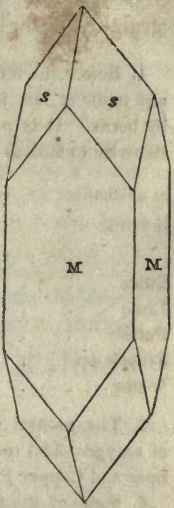


Fig. 41.

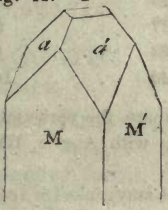


Fig. 42.

M on *s*	-	-	-	127° 59′	Hauy.
P on *s*	-	-	-	119 30	
s on *s*	-	-	-	104 2	
P on *a*	-	-	-	120° 5′	Phillips.
M on *a*	-	-	-	128 20	
a on *a*	-	-	-	104 18	

Cleavage, parallel with the primary faces, most perfect at right angles to the axis.

Fracture uneven.

Surface smooth and shining.

Lustre vitreous. The natural and cleavage face P possess pearly lustre. Color several shades of white, greyish, bluish or reddish. Streak white. Transparent . . . translucent.

Apophyllite.—Arfwedsonite.

Brittle. Hardness = 4·5 . . . 5·0. Sp. gr. = 2·335.

Compound varieties. Massive: composition lamellar, straight, or slightly curved.

1. Before the blow-pipe, it first exfoliates, then intumesces like borax, and melts at last into a white vesicular globule. It is easily dissolved by borax. It is positively electrified by friction, but not by heat. It likewise exfoliates in acids; and its powder forms with them, a jelly.

2. *Analysis.*

	By Berzelius, from Utoen.	By Stromeyer, from Faroe.
Silica	53·13	51·26
Lime	24·71	25·20
Potash	5·27	5·14
Fluoric acid	0·82	0·00
Water	16·20	16·04
	52·38	24·98	5·27	0·64	16·20	

3. The natural repositories of Apophyllite are the vesicular cavities of amygdaloidal rocks, or metalliferous beds with Augite, Calcareous Spar and Copper Pyrites.

4. Some of the finest varieties are from the amygdaloid of Iceland and the Faroe islands. Likewise near Indore in India. Under similar circumstances it occurs at Mariaberg, near Aussig in Bohemia, and the variety from thence has been called *Albin.* It has been found occupying drusy cavities of a very extensive bed of limestone in gneiss, containing ores of copper, at Czcklowa, near Orawitza in the Bannat. Other localities are New South Shetland, and several iron-mines in Sweden and Norway.

The only known localities in North America are Peter's Point and Partridge Island in the Basin of Mines, Nova Scotia.

ARFWEDSONITE. Peritomous Augite-Spar. Partsch.

Primary form. Oblique rhombic prism. M on M′ = 123° 55′, from cleavage.

Cleavage parallel with the sides of the prism, producing brilliant faces.

Arragonite.

Lustre vitreous. Color black. Opake.

Hardness inferior to Hornblende. Sp. gr. =3·44.

1. It melts easily before the blow-pipe into a black globule. With borax, it gives a glass colored by iron; with salt of phosphorus, likewise, but paler, and becoming colorless on cooling, whilst a dark grey silica-skeleton remains undissolved.

2. It occurs along with black Augite and black Sodalite in Greenland, and has generally been considered as a ferruginous variety of Hornblende, from which, however, its brilliant cleavages, the inclination of its lateral faces and inferior hardness, seem sufficiently to distinguish it as a new species.

The mineral generally taken for a variety of Hornblende in a porphyritic trap from Plymouth, (Vt.) appears to agree with the above description.

ARRAGONITE. Prismatic Lime Haloide. Mohs.

Primary form. Right rhombic prism. M on M′ = 116° 10′.

Secondary forms.

Fig. 43.

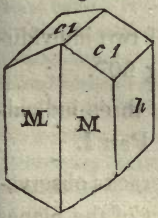
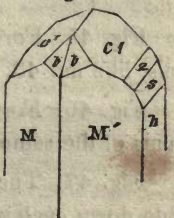


Fig. 44.



M on *c*1	- -	108° 18′	Bilin, Bohemia.
M on M′	- -	116 10	
M′ on *h*	- -	121 38	Phillips.
h on *c*1	- -	125 55	
*c*1 on *c*1	- -	108 18	
M on *b*	- -	144° 00′	
*c*1 on *c*2	- -	150 30	
*c*1 on *c*3	- -	141 00	Phillips.
*c*1 on *b*	- -	136 30	
b on *b*	- -	129 33	

Arragonite.

Cleavage, parallel with the lateral faces of the primary form.

Fracture conchoidal, uneven.

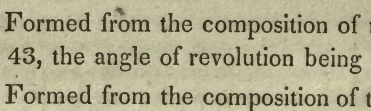
Surface generally smooth. The curvature of the sides parallel to the prismatic axis very often produces acicular crystals, variously aggregated.

Lustre vitreous, inclining to resinous upon faces of fracture. Color white, prevalent; sometimes passing into grey, yellow, mountain-green and violet blue. Streak greyish white. Transparent . . . translucent.

Brittle. Hardness=3·5 . . . 4·0. Sp. gr.=2·931, (the transparent crystals from Bohemia.)

Compound varieties.

Fig. 45. Fig. 46. Fig. 47.



Arragon.

Fig. 45. Formed from the composition of two individuals, like fig. 43, the angle of revolution being 90°.

Fig. 46. Formed from the composition of three individuals of the same form, as explained in § 73. Part I.

Fig. 47. The dotted lines represent the cracks observable down each plane, arising from the contact of the planes forming the dihedral summits of the several individuals of which fig. 46 is composed; and hence the six lateral planes of this apparently regular hexagonal prism are not flat; but each presents a slightly re-entering angle.

Globular, reniform, coralloidal shapes; surface drusy, composition columnar, the individuals being often very delicate, but also occurring of various dimensions; faces of

Arragonite.

composition irregularly streaked. Massive: composition columnar, either parallel, or divergent, or irregular; and of different sizes of individuals.

1. Thin fragments of transparent crystals decrepitate in the flame of a candle; other varieties lose their transparency, and become friable. It phosphoresces upon red-hot iron, and is soluble in nitric and muriatic acid, with effervescence.

2. *Analysis.*

By Stromeyer.

Carbonate of lime . .	95·2965 .	99·2922
Carbonate of strontites .	0·5090 .	4·1043
Water	0·1544 .	0·5992

The carbonate of strontites does not exist in constant proportions, and has not been found at all in the coralloidal varieties.

3. Imbedded crystals, generally twins, or consisting of a greater number of individuals, are found in compound varieties of Gypsum, mixed and colored with oxide of iron, accompanied by crystals of Quartz, which have likewise suffered a similar admixture. Other varieties occur in the cavities of basalt and other trap rocks, also in irregular beds and veins. It is found in beds of iron-ores, in those coralloidal varieties which have been called *Flos-ferri*, in which the component individuals are so minute that their form and structure is undistinguishable. It is also found in various repositories, along with several species, as Copper and Iron Pyrites, Galena and Malachite. It likewise occurs in lava.

4. The most beautiful crystals occur near Bilin in Bohemia, in a vein traversing basalt, and filled with a massive variety of the same species, consisting of large columnar particles of composition. The varieties of twin-crystals imbedded in Gypsum, are found in the kingdom of Arragon in Spain, from whence the name of the species has been derived. The greenish colored specimens are brought from Marienberg in Saxony, and Sterzing in the Tyrol. The finest varieties of Flos-ferri are found in the mines of Eisen-ertz in Stiria; it also occurs at Schemnitz, St. Marie mines, and in those of Baygorri and Vicdessos in the Pyrennees. In England, the Dufton lead mines furnish beautiful specimens in acicular crystals, and finely columnar masses of a satin lustre. Other localities are Mount Vesuvius, Iglo in Hungary, France, Scotland, Iceland and Silesia.

Arsenic-glance.

The Flos-ferri has been met with at Lockport, (N.Y.) coating gypsum in geodes, at Edenville, (N.Y.) lining cavities of Mispickel and Cube ore, and at Haddam, (Con.) and its vicinity, in thin seams between layers of gneiss. A fibrous variety occurs at Scoharie, (N.Y.) It also exists in numerous limestone caves of the south western states.

ARSENIATE OF COBALT. (See *Cobalt-Bloom.*)

ARSENIATE OF COPPER. (See *Aphanesite, Copper-Mica, Erinite, Euchroite, Liroconite* and *Olivenite.*)

ARSENIATE OF IRON. (See *Cube-ore.*)

ARSENIATE OF LIME. (See *Pharmakolite.*)

ARSENIATE OF NICKEL. (See *Nickel-Ochre.*)

ARSENICAL ANTIMONY GLANCE.

In reniform masses, consisting of thin and curved individuals. Fracture uneven.

Lustre shining to faint. Color tin-white to steel-grey.

Hardness = 2·0 . . . 3·0. Sp. gr. = 6·2.

1. Before the blow-pipe it melts, and during fusion emits fumes of Antimony and Arsenic. Decomposed by nitric acid, affording a white precipitate, soluble in muriatic acid.

2. It is found at Przibram in Bohemia, Allemont in Dauphiny, Poullaouen in Brittany, and Andreasberg in the Hartz.

ARSENIC-GLANCE.

Massive, botryoidal; composition columnar, individuals radiating.

Lustre metallic. Color dark lead-grey.

Hardness = 2·0 . . . 2·5. Sp. gr. = 5·2 . . . 5·5.

1. Fragments of it, held in the blaze of a lamp, take fire, and disseminate, amidst continual sparks, a greyish, arsenical vapor. Heated on platina foil, it is surrounded by a ring of crystallized arsenic acid; and as it diminishes perceptibly, the vapor is partly deposited in the form of a blackish-grey powder. Before the blow-pipe, upon charcoal, it burns, at first with a bluish flame, and disappears in a dense smoke. It does not melt, until just before it disappears, when a white metallic globule is obtained. In the matrass it gives, at first crystallized arsenic acid: afterwards, a grey smoke and metallic arsenic, without any perceptible residuum. It is soluble in nitric acid, and the solution (when the acid is

not in excess) gives a white precipitate on the addition of water. With hydriodic acid, it at first gives a blackish brown, and then a citron-yellow, precipitate.

2. *Analysis.*

By KERSTEN, from Marienberg.

Arsenic	96·785
Bismuth	3·001

3. It occurs in small quantities only, at Palmbaum in Marienberg, accompanied by Native Arsenic, Red Silver, Fluor, Heavy Spar, Calcareous Spar, Copper Nickel, Native Silver, &c.

4. It is not probable that the bismuth is a necessary ingredient in this mineral, which might with more propriety be included under Native Arsenic.

ASBESTUS.

Silky varieties of *Hornblende*, *Pyroxene*, *Picrosmene* and *Nemolite:* q. v.

ASPARAGUS-STONE. (See *Apatite.*)

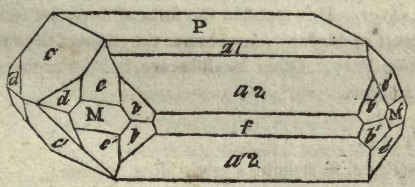
ASPHALTUM. (See *Bitumen.*)

ATACAMITE. Prismatoidal Habroneme-Malachite. PARTSCH.

Primary form. Right rhombic prism. M on M′=100°

Secondary form.

Fig. 48.



M on M′	100° 00′?	
P on *a*1	142 40	
P on *a*2	123 25	
P on *c*	127 12	
P on *e*	116 20	
*a*2 on *a*′2	112 45	PHILLIPS.
*a*2 on *c*	110 30	
*a*2 on *e*	143 25	
e on *c*′	107 10	
c on *d*	159 00	
c on *e*	137 40	
e on *e*	127 07	

The planes M M′ are the result of cleavage. Among the minute crystals are to be observed some in which the planes $a2$, $a2'$ and c, c' of fig. 48 prevail to the exclusion of the rest, converting them to the form of an octahedron with a square base.

Cleavage parallel to P, less distinct parallel to M and M′. Colors, olive, leek, grass, emerald, and blackish-green. Streak apple-green. Nearly transparent . . . translucent on the edges.

Rather brittle. Hardness = 3·0 . . . 3·5. Sp. gr. = 4·43.

1. It communicates bright blue and green colors to the flame of a candle, or if exposed to the blast of the blow-pipe, it develops vapors of muriatic acid, and melts at last into a globule of copper. It is soluble without effervescence in nitric acid.

2. *Analysis.*

	By Proust.	By Klaproth.
Oxide of copper	76·595	73·00
Muriatic acid	10.638	10.10
Water	12·767	16.90

3. It is found at Remolinos in Chili, on Brown Iron-Ore; sometimes with Red Oxide of Copper and Malachite: it occurs also in Peru with some of the ores of silver. It is found in the form of fine sand in the river Lipas, in the desert of Atacama, (and hence the name of the species,) separating Chili from Peru. Other localities are, Schwarzenberg in Saxony, and Mount Vesuvius.

Atelestite.

Crystalline, in structure resembling Sphene.
Lustre resinous to adamantine. Color pure sulphur-yellow.
Transparent to translucent.
Hardness about 3. Heavy.

1. Before the blow-pipe, it affords the indications of bismuth.
2. It is found at Schneeberg.

ATMOSPHERIC-AIR. Pure Atmospheric-gas. Mohs.

Atmospheric-Water.

Gaseous. Transparent.

Sp. gr. =1·0. Nearly 800 times lighter than distilled water.

1. It is tasteless and without odor, except that of electricity, which it sometimes very manifestly exhibits. Though transparent, it nevertheless reflects a blue color when in large masses, as in the sky above us. The lower atmosphere is contaminated in a greater or less degree by every kind of air or vapor which can be formed by the various bodies that compose the earth's surface. Over the land especially, carbonic acid is mingled with it in a proportion generally equal to 0·001.

2. *Analysis.*

Nitrogen	79·00
Oxygen	21·00

3. Atmospheric-air constitutes the atmosphere, and surrounds the whole globe to the height of forty or forty-five miles.

ATMOSPHERIC WATER. Pure Atmospheric-Water. Mohs.

Liquid. Transparent.

Sp. gr. =1·0.

1. Its form of aggregation is continually liable to fluctuation from changes of atmospheric temperature; and instead of water there appears aqueous vapor, or steam, and ice and snow. Ice is commonly produced with too much rapidity to permit the separate crystals of which its masses are composed, to be distinctly visible. They have been observed, however, by Scoresby and Herincaut de Thury, under the form of hexahedral prisms, of which the terminal faces presented striæ parallel to the faces of the prism, and in some instances with truncated terminal edges. The sp. gr. of ice = ·92. The crystals of snow present an almost endless variety of forms, which are perfect geometrical figures. They are usually lamellar, and transparent; often in regular hexagons, having six points radiating from their centres, with parallel collateral ramifications in the same plane: in slender six-sided needles, or spines; and in combinations of hexagons and spines, producing stelliform, or wheel-shaped compositions. Dr. Brewster has observed quadrangular plates in the hoar-frost crystallized upon leaves and stones; which

leads to the conclusion that the system of crystallization in ice is a quadrangular prism, and not a rhomboid, as was formerly supposed. It is well known that no species in mineralogy, whose primitive form is the rhomboid, presents crystallizations similar to the star-like figures of snow. The hail-stones which fall in the spring have the form of spheric sections, consisting of opake, thin prisms, radiating from the centre: those formed during heavy thunder storms in summer, generally, affect the shape of irregular, flattish globules, consisting of columnar particles of composition, but often perfectly transparent, and sometimes enclosing air bubbles.

2. *Analysis.*

By Berzelius.

Oxygen	88·94
Hydrogen	11·06

When pure, it is destitute of taste or odor. But water which flows within or upon the surface of the earth, contains various earthy, saline, metallic, vegetable, or animal particles, which often materially affect its taste and smell, and sometimes considerably augment its specific gravity. Thus from the accidental presence of salts and acids are formed the different kinds of hard water, of acidulous and bitter waters, and sea water.

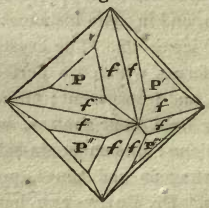
3. Pure atmospheric water descends from the atmosphere in the form of rain, mist, dew, snow or hail; it is also emitted from springs, and accumulated all over the globe in lakes, seas, &c.: in these last instances, however, it is contaminated with variable proportions of saline substances.

AUTOMOLITE. Octahedral Corundum. Mohs.

Primary form. Regular octahedron.

Secondary form.

Fig. 49.



Cleavage parallel with the primary faces.

Axinite.

Fracture conchoidal.

Surface rough, sometimes covered with Mica or Blende.

Lustre vitreous, inclining to resinous. Color dirty green tinges, inclining to black and blue. Streak white. Translucent on the edges . . . nearly opake.

Hardness = 8·0. Sp. gr. = 4·232.

Fig. 50.

Compound varieties. Twin-crystals. The octahedral hemitrope. Massive: composition granular.

1. Alone before the blow-pipe, it is infusible, and nearly so with borax, or with salt of phosphorus. With soda, it melts imperfectly into a dark scoria, which being melted again with soda, deposits upon the charcoal an areola of oxide of zinc.

2. *Analysis.*

By Eckeberg.

Alumina	60·00
Oxide of zinc	24·25
Oxide of iron	9·25
Silica	4·75

3. Automolite generally occurs imbedded in talcose slate and quartz, and is accompanied by Galena, Blende, Garnet, Gadolinite, &c. It is thus found at Fahlun and Brodbo in Sweden.

In the United States, it occurs at Haddam, (Con.) along with Chrysoberyl, Garnet and Columbite in granite.

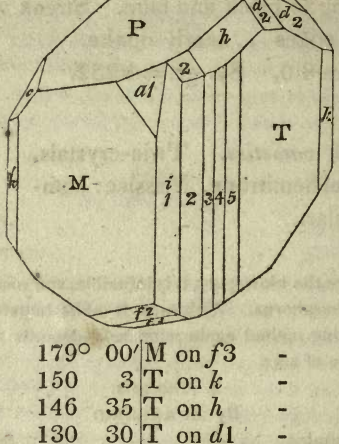
AXINITE. Tetarto-prismatic Axinite.

Primitive form. Doubly oblique prism? P on M = 134° 40′, P on T = 115° 17′, M on T = 135° 10′ (Phillips.)

Axinite.

Secondary form.

Fig. 51.



M on *a*1	-	179°	00′	M on *f*3	-	90°	18′
M on *a*2	-	150	3	T on *k*	-	147	55
M on *h*	-	146	35	T on *h*	-	152	5
M on *d*1	-	130	30	T on *d*1	-	149	30
M on *d*2	-	100	45	T on *d*2	-	130	5
M on *d*3	-	72	38	T on *d*3	-	94	12
M on *i*1	-	179	20	P on *a*1	-	133	25
M on *i*2	-	174	40	P on *c*	-	136	22
M on *i*3	-	152	25	P on *f*1	-	173	20
M on *i*4	-	142	28	P on *h*	-	143	20
M on *i*5	-	138	10	P on *d*1	-	139	30
M on *k*	-	120	00	P on *d*2	-	121	30
M on *c*	-	112	25	P on *d*3	-	110	20
M on *f*2	-	135	12				

PHILLIPS.

Cleavage indistinct and interrupted.

Fracture conchoidal, uneven.

Surface of M and T irregularly streaked. The secondary faces are smooth and shining.

Lustre vitreous. Color clove-brown, various shades inclining to plum-blue and pearl-grey. Green from an ad-

Axinite.

mixture of Talc. Streak white. Transparent . . . translucent, sometimes only on the edges. It exhibits the property of dichroism.

Hardness = 6·5 . . . 7·0. Sp. gr. = 3·271.

Compound varieties. Massive: composition lamellar, generally a little bent; faces of composition irregularly streaked. Sometimes the composition is granular and impalpable.

1. Before the blow-pipe it melts easily, and with intumescence, into a dark-green glass, which becomes black in the oxidating flame. Some varieties are differently electrified by heat, contiguous to opposite ends of the crystals, and in these also a difference has been observed by HAUY.

2. *Analysis.*

	By KLAPROTH.	By WIEGMANN.
Silica	50·50	45·00
Lime	17·00	12·50
Alumina	16·00	19·00
Oxide of iron	9·50	12·25
Oxide of manganese	5·25	9·00
Potash	0·25	0·00
Magnesia	0·00	0·25
Boracic acid	0·00	2·00

3. Axinite occurs in beds and veins in primitive countries. It is accompanied in the former situations by Calcareous Spar, Blende, &c.; in the latter, chiefly by Augite, Quartz, Feldspar and various metallic minerals.

4. It is found in beds at Thum near Ehrenfriedersdorf in Saxony, from whence it has sometimes been called *Thumite* or *Thumerstone*. At Kongsberg in Norway, it occurs in veins with Vitreous Silver. Beautiful crystals are met with in the veins of various places near Bourg d'Oisans in Dauphiny, at Barèges in the Pyrenees, in Savoy, in the county of Gömör in Hungary, and in large, well defined crystals at Botallack in Cornwall. In the latter place, it is found in a massive state, forming a peculiar kind of rock with Garnet and Tourmaline. It is also found at several places in the Hartz.

AZOTE. (See *Nitrogen.*)

AZURITE. (See *Lazulite.*)

BABINGTONITE. Axotomous Augite-Spar. PARTSCH.

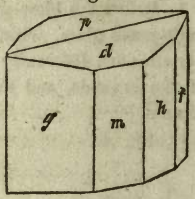
Primary form. Oblique rhombic prism. Dimensions unknown.

Secondary form.

p on *m*	-	-	92°	34′
p on *t*	-	-	88	00
t on *h*	-	-	155	25
m on *t*	-	-	112	30
m on *h*	-	-	137	·5
p on *d*	-	-	150	25
g on *m*	-	-	132	15
h on *g*	-	-	89	20

LEVY.

Fig. 52.



Cleavage distinct, parallel to *p* and *t*.

Fracture imperfectly conchoidal.

Lustre vitreous. Color black, often greenish; thin splinters are faintly translucent, and of a green color, perpendicular to *p*, of a brown color parallel to it. In large crystals, it appears opake.

Hardness = 5·5 ... 6·0.

1. According to Mr. CHILDREN, it is composed of silica, iron, manganese and lime, with a trace of titanium.

2. It occurs at Arendal in Norway, in small crystals, (resembling dark colored crystals of Pyroxene,) disposed on the surface of crystals of Albite; and at Governeur, (N.Y.) coating crystals of Feldspar.

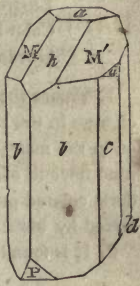
BARYTO-CALCITE. Hemi-Prismatic Hal-Baryte. MOHS.

Primary form. Oblique rhombic prism. M on M′ = 106° 54′.

Baryto-Calcite.

Secondary form.

Fig. 53.



M on M′	106°	54′
M on P	102	54
b on *b*	95	15
h on the edge between *b* and *b*	119	00
P	135	00
c on *c*	145	54

Cleavage perfect parallel to M and M′; less easily obtained, though perfect, parallel to P.

Fracture uneven, imperfectly conchoidal.

Surface *h* striated parallel to the edges of combination with M; the vertical planes parallel to the axis.

Lustre vitreous, inclining to resinous. Color white, greyish yellowish, or greenish. Streak white. Transparent... translucent.

Hardness =4·0. Sp. gr. =3·66.

Compound varieties. Massive: composition granular.

1. It does not melt alone before the blow-pipe, but gives a clear globule with borax. Like Witherite, it is soluble in muriatic acid.

2. *Analysis.*

By CHILDREN.

Carbonate of barytes . . .	65·9
Carbonate of lime . . .	33·6

It sometimes gives traces of iron and manganese.

3. It occurs at Alston moor in Cumberland, both massive and crystallized.

BATRACHITE.

Massive, with traces of a rhombic prism of 115°. Composition impalpable.

Beryl.

Cleavage parallel with the sides and shorter diagonal of the above prism, but mostly indistinct. Fracture small conchoidal.

Lustre resinous or vitreous; more inclined to the latter.

Color light greenish-grey, to almost white. Streak white.

Hardness = 5·0. Sp. gr. = 3·038.

1. Before the blow-pipe, it is fusible alone, without any perceptible change in the color of the flame. It affords a little moisture when heated in the matrass. It is slowly dissolved in phosphoric salt, leaving behind flocculi of silica. With soda, it is with difficulty dissolved into a dark colored pearl. From these and other experiments, it has been inferred by MERLET to be a silicate of magnesia.

2. It is found at Rizoni, a mountain in southern Tyrol.

BERGMANITE. (See *Scapolite.*)

BERYL. Rhombohedral Emerald. MOHS.

Primary form. Regular hexagonal prism.

Secondary forms.

Fig. 54.

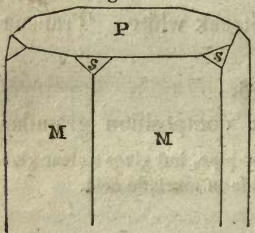
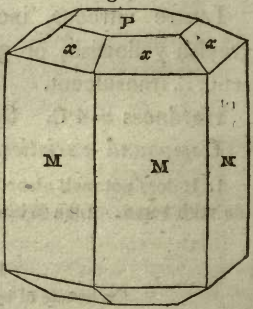


Fig. 55.



P on *s*	-	-	135°	00	HAUY.
M on *s*	-	-	127	45′ 40″	
P on *t*	-	-	150	00	
M on *t*	-	-	120	00	

Beryl.

Fig. 56.

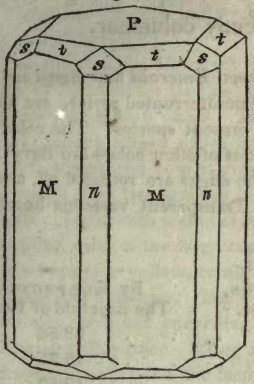
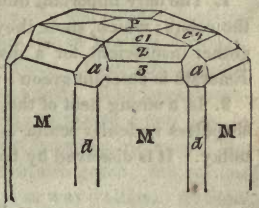


Fig. 57.



M on *n*	- -	150° 00	}	Hauy.
n on *s*	- -	135 00		
s on *t*	- -	156 42′ 59″		
P on *a*	- -	135 14′	}	Phillips.
P on *c*2	- -	159 10		
*c*1 on *c*′1	- -	179 40		
M on *d*	- -	150 00		

Cleavage, parallel to all the primary planes, but not distinct.

Fracture conchoidal, uneven.

Surface, the prisms striated parallel to the axis.

The pyramidal faces smooth.

Lustre vitreous. Color green, passing into blue, yellow and white: the brightest of these colors is emerald green; the greater part of the species, however, exhibits only pale colors. Streak white. Transparent... translucent.

Hardness=7·5...8·0. Sp. gr.=2·732 of a perfectly emerald green variety; 2·678, of an apple-green crystal.

Beryl.

Compound Varieties. Massive: composition generally large granular, sometimes imperfectly columnar.

1. The only important differences between *Emerald* and *Beryl* are in the colors; which, since they produce an uninterrupted series, are altogether insufficient for a division of the present species. The color of Emerald is emerald green; all the varieties of other colors are Beryl.

2. In a strong heat of the blow-pipe, the edges are rounded off, and a shapeless vesicular scoria is produced. Transparent varieties become milky. It is dissolved by borax.

3. *Analysis.*

	By Berzelius, from Broddbo.	By Klaproth. The Emerald of Peru.
Silica	68·35	68·50
Alumina	17·60	15·75
Glucina	13·13	12·50
Oxide of iron	0·72	1·00
Oxide of columbium	0·27	0·00
Oxide of chrome	0·00	0·30
Lime	0·00	0·25

4. Beryl occurs in imbedded crystals in various rocks, most generally, however, in granite. It is also found in implanted crystals in veins and in beds. It is associated with Feldspar, Chrysoberyl, Topaz, Tin-ore, Garnet, &c. It is met with, likewise, in fractured crystals and rolled masses in secondary repositories.

5. The finest crystals of the emerald-green colors, or the true Emerald, come from Peru, where, according to Humboldt, it forms druses with Calcareous Spar, and occurs in veins traversing hornblende-slate, clay-slate and granite. It is sometimes accompanied by Quartz and Iron Pyrites. Less beautiful varieties are found imbedded in mica-slate in the valley of Heerbach, district of Pinzgau, Salzburg. The ancients procured their Emeralds from Egypt. Their localities have been rediscovered, and are situated in granite and mica-slate, in Mount Zalara, seven leagues from the Red Sea in Upper Egypt. Transparent crystals of bluish-green Beryl (called *Aquamarine*) are found in Siberia and Brazil. In Siberia it occurs in the granitic district of Nertschinsk, on the confines of China in compact ferruginous clay; also in the Uralian and Altai mountains, often in large crystals: in Brazil, it is found in fractured crystals in the sand of rivers. More common varieties are met

with at Limoges in France, near Zwiesel on the Rabenstein in Bavaria, at Finbo and Broddbo in Sweden, and in some of the tin mines of Saxony and Bohemia.

The Beryl is an abundant mineral throughout New England; and many of its localities are distinguished for the size and perfection of the crystals which they afford. The most remarkable of these is Acworth, (N.H.) about fifteen miles from Bellows' Falls. They occur at this place in a powerful vein of granite traversing gneiss. The largest crystals weigh from two to three hundred pounds, and measure four feet in length. Their form is that of tolerably perfect hexagonal prisms. The prevailing color of the large crystals is a pale bluish green: the smaller crystals are pale yellow, rarely a deep honey, or wax-yellow. At Bowdoinham and Topsham, (Me.) this species is found in veins of graphic granite in small but exceedingly regular crystals, of a pale greenish or yellowish white color. They are mostly imbedded in a brown Quartz; and sometimes present the form of fig. 55. A few crystals of the emerald green color have been met with at Topsham. The Albite granite of Goshen and Chesterfield afford small and irregular crystals of pale green colors, some of which are transparent. In Connecticut at Haddam, large crystals of the yellow and yellowish-green varieties, occur at the chrysoberyl vein, many of which contain implanted crystals of Chrysoberyl and Columbite. A seam of Brown Quartz in a vein of mica slate in the same town, has afforded very beautifully transparent crystals of the form represented in fig. 56: the quarries of gneiss in the neighborhood on both sides of the Connecticut river, produce green prisms of the common variety. At Monroe, a vein of graphic granite furnishes uncommonly handsome crystals as respects their regularity and the number of crystals of different sizes implanted within a small mass of the rock.

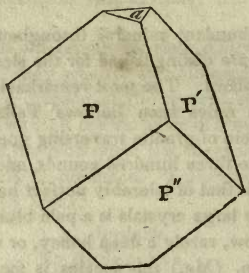
6. Beryl, when clear and transparent, and of a fine emerald green color, is highly valued as a gem: the bluish colored crystals are not so highly prized, but are employed for the same purpose.

BEUDANTITE.

Primary form. Rhomboid. P on P′=92° 30′.

Secondary form.

Fig. 58.



Cleavage parallel with *a*.

Surfaces curved; generally brilliant.

Lustre resinous. Color black; in thin fragments, translucent, and of a deep brown color. Streak greenish-grey.

Hardness = 4·0 . . . 4·75.

Compound varieties. Massive: composition not described.

1. It consists of the oxides of iron and lead.

2. Its locality is Horhausen on the Rhine, where it seems associated with Brown Iron-Ore.

3. The want of a knowledge of the specific gravity of this mineral prevents us from referring it to its natural historical genus. The properties above enumerated, however, prove it with sufficient distinctness to be a peculiar species.

BI-SELENIURET OF ZINC. (See *Rionite.*)

BISMUTH BLENDE. Tetrahedral Bismuth Baryte.

Primary form. Unknown.* Implanted globular shapes. Massive: composition thin columnar, impalpable, also curved lamellar.

* HARTMANN gives the Tetrahedron as the primary form of this species, and describes its crystals as occurring in tetrahedra, with their edges deeply bevelled, and like fig. 55, P. I.

Fracture imperfectly conchoidal or uneven.

Lustre resinous. Color dark hair-brown, yellowish-grey and straw-yellow. Streak yellowish-grey. Translucent or opake.

Rather brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 5·9 . . . 6·0.

1. It decrepitates briskly before the blow-pipe, emits an arsenical odor, and is finally converted into a glass, which effervesces with borax.

2. *Analysis.*

By HUNEFELD.

Carbonate of bismuth	58·8
Arsenic acid	2·2
Silica	23·8
Arsenic, cobalt, copper and iron . . .	5·9
Gangue	9·1

3. It occurs with Quartz at Schneeberg in Saxony.

BISMUTHIC COBALT-ORE.

The description of this species, as put forth by KERSTEN, is too defective to enable us to decide whether it is entitled to rank as a distinct species. It is described as massive, having a lead or steel-grey color, a feebly metallic lustre and a sp. gr. from 6·0 . . . 7·8. It is believed to consist of arsenic, cobalt and bismuth. It occurs with other ores of cobalt at Schneeberg in Saxony.

BISMUTHINE. Prismatic Polypoione-Glance.

Primary form. Right rhombic prism. M on M=nearly 91°.

Secondary form.

The lines parallel to the plane *f*, represent the striæ constantly observed on the crystals, but which in reality are a series of planes.

Fig. 59.

Cleavage parallel to the planes P and *f*, most perfec parallel with the latter, and at right angles to *f*, affording the measurement of 90° by the reflective goniometer Fracture scarcely observable. Surface of the prisms deeply streaked parallel to the axis.

Lustre metallic. Color lead-grey, inclining a little to steel-grey. Streak unchanged.

Rather sectile. Hardness = 2·0 ... 2·5. Sp. gr. = 6·549.

Compound varieties. Massive: composition granular, the individuals being of various sizes; or columnar, individuals straight and aggregated in various directions.

1. It is volatilized before the blow-pipe, and covers the charcoal with a yellow areola. It is easily fusible, and emits continually small drops in a state of incandescence. It is easily soluble in nitric acid, and the solution yields a white precipitate on being further diluted.

2. *Analysis.*
By SAGE.

Bismuth	60·00
Sulphur	40·00

3. It occurs principally in veins, but is also found in beds, and is generally associated with Native Bismuth.

4. It is a rare mineral. Its localities are, Altenberg, Schneeberg, Joachimsthal, Rezbanya, Cornwall, Riddarhyttan in Sweden, Beresof in Siberia, at Canock in Cumberland.

It has been noticed at a single spot in the United States, in the celebrated Chrysoberyl locality of Haddam, (Con.)

BISMUTH-OCHRE. Bismuthic Lusine-Ore.

Massive: composition impalpable; earthy and pulverulent. Fracture conchoidal to earthy.

Color straw-yellow, or greyish yellow.

Soft. Sp. gr.=4·36.

1. Upon charcoal, it is easily reduced to the metallic state, attended y a peculiar odor. It is soluble in nitric acid,—the solution throwing own a white precipitate on the addition of water.

2. *Analysis.*

Oxygen	10·13
Bismuth	89·87

It frequently occurs mixed with carbonate of bismuth and iron.

3. It is found in small quantity upon the ores of bismuth, cobalt and ickel, at Schneeberg in Saxony, Joachimsthal in Bohemia, Saint Agnes n Cornwall, Siberia; and at Haddam, (Con.) in the chrysoberyl rock, where it is sometimes accompanied by Bismuthine.

BITTER-SPAR. (See *Dolomite.*)

BITUMEN. Black Mineral-Resin. MOHS.

Aggregation solid or fluid, and all the intermediate stages. No regular form. Stalactitic shapes: surface smooth. Massive.

Fracture conchoidal, more or less perfect, uneven.

Lustre resinous. Color black, passing into various brown and red tints. Fluid varieties are sometimes perfectly colorless. Streak commonly unchanged, sometimes lighter than the color. Translucent on the edges, opake; some fluid varieties are transparent.

Sectile, malleable, elastic. Bituminous odor. Hardness = 0·0 . . . 2·0. Sp. gr. = 0·828, brown, malleable; 1·073, black, slaggy; 1·160, hyacinth-red, slaggy.

1. *Mineral Oil* and *Mineral Pitch* have been treated as two species; the former embracing under it as varieties Naphtha and Petroleum, and the latter Earthy Bitumen, Elastic Bitumen, and Compact Bitumen or Asphaltum; but all these varieties differ in nothing except their state of aggregation, which, however, forms an uninterrupted series from those which are perfectly fluid to such as are perfectly solid. The Mineral

Bitumen.

Oil is first inspissated, and then it is changed into Mineral Pitch by fur ther exposure to the air. Naphtha embraces yellowish and nearly trans parent varieties of the fluid Bitumen, while Petroleum consists of thos which have the consistence of tar, together with a black color. Elasti Bitumen is distinguished by its elasticity. Earthy Bitumen has an ear thy fracture, while Asphaltum possesses a more or less conchoidal frac ture. Still, all these varieties are joined by transitions, which prove that they form but a single natural historical species.

2. Mineral oil is easily inflammable, and burns with a white flam and much smoke. Also the Mineral Pitch is very inflammable, an burns with a bituminous smell; some varieties melt in a higher tempe rature.

3. *Analysis.*

	By THOMSON, of Naphtha.	of Elastic Bitumen
Carbon	82·20	52·25
Hydrogen	14·80	7·49
Azote	0·00	0·15
Oxygen	0·00	40·11

4. The fluid varieties of Bitumen ooze out of several rocks, as sand stone, slaty clay, &c., or they are found on the surface of springs an lakes. The elastic variety is found in limestone rocks along with Gale na; the earthy in beds with limestone, but associated with members o the coal formation. The Asphaltum is imbedded in nodules in limestone in agate balls, in veins with Galena, Fluor, &c.; also in beds, and on the shores and waters of certain lakes.

5. Fluid varieties have been found in various districts of Italy, in Si cily, in Zante, in the Caspian Sea, in Persia and other countries in Asia. Elastic Bitumen (sometimes called mineral *Caoutchouk*) occurs at Cas tleton in Derbyshire. Earthy Bitumen is found near Neufchatel in Switzerland, at Grund in the Hartz, in Dalmatia, &c. Asphaltum forms nodules in limestone at Bleiberg in Carinthia, in sandstone in Albania, in great abundance in the island of Trinidad, and in large pieces on the shores, or floating on the surface of the Asphaltic lake in Judea, called the Dead Sea.

The United States and the Canadas afford numerous localities of the more fluid and soft varieties of Bitumen. Petroleum occurs on the Ken hawa in Virginia, on a spring of water five miles from Scottsville, Allen co. (Ken.) at several places in the western part of Pennsylvania, at Duck

Creek in Munroe co. (Ohio,) and in Liverpool in the same state, where a salt well, while boring, yielded about fifteen gallons per day. In New York, it is found floating upon the surface of Seneca Lake, and is hence known in commerce under the name of *Genesee* or *Seneca*-Oil. In Woodbury, and some other places in Connecticut, the Elastic Bitumen is found in connexion with a bituminous limestone. The black limestone in the vicinity of Quebec affords exudations of Petroleum.

6. The different varieties of Bitumen allow of considerable application for illuminating, for fuel in fire-works, in the manufacture of varnish and of black sealing-wax. Mingled with grease or common pitch, it is used for paying the bottoms of ships. The ancients employed Bitumen in the construction of their buildings; the bricks of which the walls of Babylon are built are cemented with hot bitumen. The Egyptians are also said to have employed it for the embalming of bodies.

BITUMINOUS COAL. Bituminous Mineral Coal. Mohs.

No regular form or structure. Fracture conchoidal, uneven.

Lustre resinous, more or less distinct. Color black or brown, passing in earthy varieties into greyish tints. Sometimes exhibits tarnished colors. Streak unchanged, except that it sometimes becomes shining. Opake.

Sectile, in different degrees. Hardness $=1{\cdot}0 \ldots 2{\cdot}5$. Sp. gr. $=1{\cdot}223$, moor-coal from Teplitz; $=1{\cdot}270$ common brown coal from Eibiswald in Stiria; $=1{\cdot}271$, black coal from Newcastle; $=1{\cdot}288$, bituminous wood; $1{\cdot}423$, cannel coal from Wigan in Lancashire.

Compound Varieties. Massive: composition lamellar, faces of composition smooth and even, different gradations; granular texture often impalpable, in which case fracture is uneven, even or flat conchoidal. Ligniform shapes, the structure of which resembles that of wood, sometimes very distinct, but often obliterated, with the exception of some

slight traces, when the fracture becomes conchoidal across the fibres. There are some earthy varieties of a loose friable texture.

1. The present species is treated by some writers as forming four separate species: viz. *Brown Coal*, *Black Coal*, *Cannel Coal* and *Jet*; and the two first mentioned varieties have been again divided into several sub-species. The color of Brown Coal is brown, as its name imports. It possesses a ligneous structure, or consists of earthy particles. Its varieties are as follows: *Bituminous Wood*, which presents a ligneous texture, and very seldom any thing like a conchoidal fracture, and is without lustre; *Earthy Coal*, consisting of loose friable particles; *Moor Coal*, or *Trapezoidal Brown Coal*, distinguished by the want of ligneous structure, and by the property of bursting and splitting into angular fragments, when removed from its original repository; *Common Brown Coal*, which, though it still shows traces of ligneous texture, is of a more firm consistency than the rest of the varieties, and possesses higher degrees of lustre upon its more perfect conchoidal fracture. The color of *Black Coal* is black, without inclining to brown, and it is destitute of the ligneous texture. Some of its varieties immediately join those of Brown Coal. They are: *Pitch Coal*, of a velvet black color, generally inclining to brown, strong lustre, and presenting in every direction a large and perfect conchoidal fracture; *Slate Coal*, possessing a more or less coarse, slaty structure, which, however, seems to be rather a kind of lamellar composition, than real fracture; *Foliated Coal*, which is similarly compounded, only the laminæ are thinner; *Coarse Coal* has a composition resembling it, only the component particles are smaller, and approach to a granular appearance. *Cannel Coal* is without visible composition, and has a flat conchoidal fracture in every direction, but with little lustre, by which it is distinguished from Pitch Coal. It most resembles the Moor Coal, but the difference in their specific gravity is greater than between almost any other two varieties of coal. Jet occurs in elongated reniform masses, and sometimes in the shape of branches with a regular woody structure. Its lustre is brilliant, and its fracture perfectly conchoidal. All these kinds, however, are united by numerous transitions, so that it continually becomes doubtful to which of them we should refer certain specimens, though thoy are undoubtedly Bituminous Coal.

2. Bituminous Coal is more or less easily inflammable, and burns with flame and a bituminous smell. Several varieties become soft, and others

coak when kindled. They have a more or less considerable earthy residue.

3. *Analysis.*

By Thomson.

	Newcastle or caking coal.	Cannel Coal.
Carbon	75·28	64·72
Hydrogen	4·18	21·56
Azote	15·96	10·72
Oxygen	4·58	0·00

4. The varieties called slate coal, foliated coal, and pitch coal, occur chiefly in the coal formation; some varieties of pitch coal, also the moor coal, bituminous wood, and common brown coal, are met with in the formations above the chalk; the earthy coal, and some varieties of bituminous wood and common brown coal, are often included in diluvial and alluvial detritus. The coal seams alternate with beds of slaty clay and common clay, sandstone, limestone, sand, &c. They are often associated with vegetable organic remains in slaty clay, sometimes also with shells. Generally there is more or less Iron Pyrites and White Iron Pyrites mingled along with them, and they are sometimes traversed by veins of Galena.

The present species is so universally distributed, that only a few localities can here be mentioned as examples. Bituminous wood is found in considerable quantity in Iceland, and is called *Surturbrand;* in the Meissner mountain in Hessia, in the Westerwald, at Voitsbey in Stiria, and at Bovey in Devonshire. Earthy coal is found at Merseberg, Halle, Bernburg, and at Eisleben in Thuringia. Moor coal occurs in the northern districts of Bohemia. Common brown coal occurs in immense quantities on the river Sau, and on the foot of the Schwaneberg Alps. Pitch coal is likewise found in the Meissner, in Saxony, Silesia, on the Rhine, and in France. Slaty coal occurs at Potschappel in Saxony, in Silesia, in Westphalia, and particularly at Newcastle, White haven, and other places in England and Scotland. *Paper Coal,* which occurs in thin paper-like seams, is found in Saxony and Sicily. Cannel coal exists abundantly in Lancashire and Shropshire in England and in Scotland. Jet is brought from the Prussian amber mines, and is met with at a considerable depth, between beds of sandstone, at several places in France.

Bituminous Coal exists in the greatest quantity throughout extensive portions of the States of Pennsylvania, Virginia and Ohio. From Gallipolis to the Falls of the Ohio, coal of the best quality may be bought for

ten cents the bushel; and at Pittsburg, where it is most abundant, its price is six cents the bushel. According to Maclure, the independent coal formation extends from the waters of the Ohio to the waters of the Tombigbee. The coal of this region is chiefly a very pure slate coal; and is often beautifully tarnished with the richest iridescence. At some places upon the Ohio, however, extensive deposits of the purest pitch coal are found. The secondary region of the Connecticut river affords occasionally traces of Bituminous Coal, not only in its sandstones and slates, but in its trap; but is no where likely to be found in sufficient quantity to be explored.

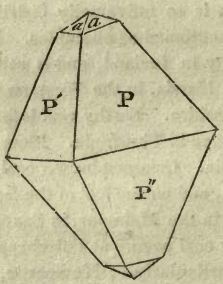
5. The important uses of this species for fuel are well known. Cannel coal and jet are wrought for ornamental purposes.

BLACK MANGANESE. Pyramidal Manganese-Ore. Mohs.

Primary form. Octahedron with a square base. P on $P'' = 117° 30'$.

Secondary form.

Fig. 60.



a on *a* - - - 139° 56′

Cleavage, parallel to the base of the primary form perfect; less distinct and interrupted parallel with the octahedral faces.

Fracture uneven.

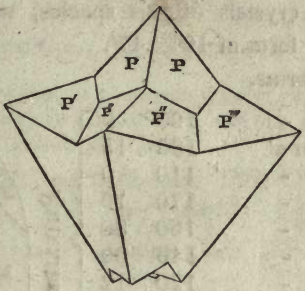
Lustre imperfect metallic. Color brownish black. Streak dark reddish or chesnut-brown. Opake.

Black Manganese.

Hardness = 5·0 . . . 5·5. Sp. gr. = 4·722 of a crystallized variety.

Compound Varieties. Twin crystals. Common octahedral hemitrope; also repeated a second time,

Fig. 61.



Massive: composition granular, firmly connected.

1. Before the blow-pipe on charcoal, in a strong heat, it fuses on the edges and assumes a blackish-grey color. With borax, it is easily dissolved, giving in the exterior flame an amethystine blue color, and in the interior a feeble tinge of iron. With salt of phosphorus, it dissolves rapidly with effervescence, and attended with a deep blue color, which disappears in the reduction-fire of the instrument.

2. *Analysis.*

It is not absolutely certain that the Black Manganese has as yet been subjected to analysis, although it is extremely probable that the variety of Manganese from Piedmont, analysed by BERZELIUS, belongs to this species. It consisted of

Oxide of manganese	75·80
Silica	13·17
Oxide of iron	4·14
Alumina	2·80

3. It has been found in veins in porphyry, along with other ores of manganese, at Ochrenstock, near Ilmenau in Thuringia, and at Ihlefeld in the Hartz. In the United States, it occurs at Lebanon, (Penn.) It is yet a rare substance.

BLACK SILVER. Prismatoidal Polypoione-Glance.

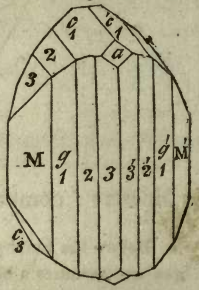
Primary form. Right rhombic prism. M on M′=100° 0′. The dimensions of the primary form, however, cannot be considered as fixed, since LEONHARD and HARTMANN describe crystals of this species, which appear to have a primary form of 107° 47′.

Secondary forms.

M on M′	-	100°	0′
M or M′ on *a* or *a*′		135	15
M on *c*1	-	110	0
M on *g*1	-	170	10
M on *g*2	-	160	30
M on *g*3	-	146	30
a on *c*1	-	120	12
a on *c*2	-	145	24
a on *c*3	-	143	25
*c*3 on *c*3	-	122	15

PHILLIPS.

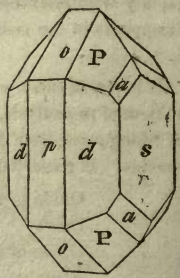
Fig. 62.



Himmelsfurst mine, Freiberg.

Fig. 63.

d on *d* over *p* - 72° 13′ HARTMANN.



Przibram, Bohemia.

p, *s* and *o* are tangent planes.

The mutual inclinations of the pyramidal faces P, which correspond to the lateral edges of the primary form, are 130° 16′ and 104° 19′. It also occurs in crystals, destitute of the faces *o* *p* and *a*.

Cleavage parallel to M and M′ easy, and in other directions, of the variety from Freiberg. The variety from Przibram has indistinct cleavages.

Black Silver.

Surface of the prisms striated vertically.

Lustre metallic. Color iron-black. Streak unchanged. Sectile. Hardness $=2\cdot0 \ldots 2\cdot5$. Sp. gr. $=6\cdot269$ from Przibram; $=5\cdot5$, from Freiberg.

Compound Varieties. Twin-crystals like those of Arragonite. (q. v.) Massive: composition granular, individuals strongly connected; fracture uneven.

1. Before the blow-pipe, upon charcoal, it yields a dark colored metallic globule, which may be reduced either with soda and silver, or with nitre. It is soluble in dilute nitric acid.

2. *Analysis.*

	By Klaproth.	By Brandes, from Freiberg.
Silver	66·50	65·50
Antimony	10·00	0·00
Arsenic	0·00	3·30
Iron	5·00	5·46
Sulphur	12·00	19·40
Copper and arsenic	0·50	0·00
Copper	0·00	3·75

3. Black Silver occurs in silver-veins along with other ores of silver, also with Galena, Blende, Copper and Iron Pyrites, Heavy Spar, &c. It is sometimes associated with Native Arsenic and Native Gold. Its compact varieties are often intimately mixed with Galena and with Stibine,—a mixture designated by the name of *White Silver*, the *Weissgeltigerz* of Werner. The richer it is in silver, the more it approaches in its properties to the pure varieties of Black Silver; while in the contrary cases, it presents more nearly the characters of compact Galena and of compact Stibine, or of a mixture of both. It occurs in the silver veins of Saxony.

4. Black Silver is found chiefly in Saxony, Bohemia and Hungary; in the last of which countries it is called Röschgewächs. Its chief localities in Saxony are the mining districts of Freiberg, Schneeberg, and Johanngeorgenstadt; in Bohemia, those of Przibram and Ratieborzitz; and in Hungary those of Schemnitz and Cremnitz. It is found also in small quantities in Andreasberg in the Hartz; and at Zacatecas in Mexico, and in Peru, as well as in Siberia.

Black Tellurium.

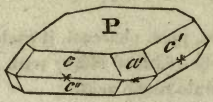
5. On account of the large proportion of silver which it contains, it is a valuable ore for the extraction of that metal.

BLACK TELLURIUM. Prismatic Polypoione-Glance.

Primary form. Right square prism.

Secondary form.

Fig. 64.



x on x	-	-	90°	00′	c. g.	PHILLIPS.
x on x'	-	-	135	00	c. g.	
P on a	-	-	118	35		
P on c	-	-	110	00	c. g.	

Cleavage parallel with P, perfect.

Fracture not observable.

Surface P smooth.

Lustre metallic. Color blackish lead-grey. Streak unchanged.

Highly flexible in thin laminæ. Very sectile. Hardness = 1·0 ... 1·5. Sp. gr. = 7·085.

Compound varieties. Massive: composition granular, of various sizes of individuals, sometimes longish.

1. Before the blow-pipe, upon charcoal, it melts easily, emits white fumes, which are deposited upon the charcoal, and gives a metallic globule. With borax, it gives a bead of gold containing a little silver. It is easily soluble in nitric acid.

2. *Analysis.*

By KLAPROTH.

Tellurium	32·20
Lead	54·00
Gold	9·00
Silver	0·50
Copper	1·30
Sulphur	3·00

3. It has been found only in veins with Native Gold, Galena, Blende and Carbonate of Manganese.

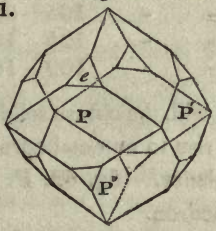
4. Its chief locality is Nagyag in Transylvania, from whence it obtained its old name of *Nagiaker-Erz*. It is found also with Graphic Tellurium at Offenbanya in the same country.

BLENDE. Dodecahedral Sclerone-Blende.

Primary form. Rhombic dodecahedron.

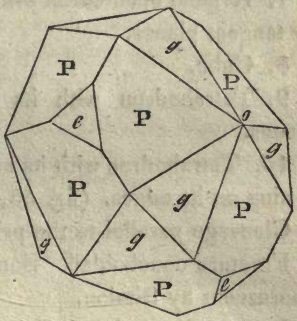
Secondary forms.

1. Fig. 65.



2. Fig. 66.

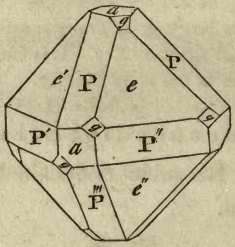
Four of the obtuse solid angles are replaced by tangent planes, while the remaining four are unaltered, except that they are formed from six instead of three plane angles, as may be seen in the angle at *o*.



P on *e*	- - -	144°	44′ 08″	Hauy.
g on *g*	- - -	129	31 18	

Blende.

3. Fig. 67.



P on *a*	-	-	135°	00′	00″	} Hauy.
a on *e*	-	-	125	15	52	
c on *c*	-	-	109	18	16	

4. Dodecahedron with the obtuse solid angles deeply truncated, so as to give rise to an octahedron with its edges replaced by tangent planes. (fig. 62. P. I.)

5. Regular octahedron.

6. Tetrahedron.

7. Regular octahedron with its edges and angles replaced by tangent planes.

8. Cube.

9. Tetrahedron with its angles replaced by tangent planes.

10. Tetrahedron with its angles replaced by three planes resting on its edges. (fig. 55. P. I.)

Cleavage parallel to the primary faces, perfect.

Fracture conchoidal. Some yellow varieties are phosphorescent by friction.

Lustre adamantine. Color green, yellow, red, brown, black, none of these bright. Streak white to reddish-brown, corresponding to the color. Transparent... translucent,

Blende.

Brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 4·078, a cleavable variety; =4·027, a columnar, compound variety.

Compound Varieties. Twin-crystals. Octahedral hemitrope. (fig. 50.) This composition is repeated, as in fig. 61, and sometimes for a number of times. Reniform and other imitative shapes: surface rough; composition columnar, often almost impalpable; straight, divergent, and frequently producing a second curved lamellar or granular composition. Massive: composition columnar, or granular, sometimes impalpable, often very distinct. The fracture of impalpable compositions is uneven or even.

1. Although the subspecies distinguished by the earlier writers on mineralogy among the varieties of Blende, have been denominated after their colors, yet they do not depend entirely or solely upon these colors. *Yellow Blende* includes the more transparent varieties, whether of a green, yellow or reddish-brown color. *Brown Blende* consists of the more opake red and brown varieties. *Black Blende* is either black and opake, or blood-red. Brown Blende has been further divided into *foliated*, *radiated* and *fibrous* brown Blende: simple varieties and compound ones, consisting of granular individuals, are contained in the first of these divisions; columnar compositions, in which the individuals are still discernible in the second; and very thin columnar or impalpable compositions originating from them, which assume various imitative shapes, are comprehended in the third division. The exact distinction of the above varieties, requires much practice, and can be acquired only empirically; and even then many varieties will occur that render the distinction impossible, which is proof that the distinction itself is useless.

2. When strongly heated in the oxidating flame of the blow-pipe, it gives off vapors of zinc, which form a coating on the charcoal, but it does not melt. It is soluble in nitric acid, during which process sulphuretted hydrogen is evolved.

3. *Analysis.*

	By Thomson.	By Gueniveau.
Zinc	59·09	62·00
Iron	12·05	1.50
Sulphur	28·86	34·00

4. Blende is an abundant and widely diffused ore; but all its varieties are not equally common. It is found in beds and veins, accompanied by Galena, Copper Pyrites, Heavy Spar, Fluor, Spathic Iron, &c. It also occurs in silver veins associated with Native Silver and other ores of that metal.

5. Yellow Blende principally occurs in fine varieties at Schemnitz in Lower Hungary, and at Kapnick in Transylvania; also in Saxony, at Ratieborzitz in Bohemia, at Gummesud in Norway, and other places. Brown Blende is found at Freiberg and other localities in Saxony, Bohemia, the Hartz, Sweden, and in great quantities in Derbyshire, Cumberland and Cornwall in England. The radiated variety, in particular, is found at Przibram; it is this variety in which STROMEYER detected the metal Cadmium. The fibrous Blende occurs at Geroldseek in the Brisgau, and at Raibel in Carinthia. Black Blende comes from Freiberg, Annaberg, Breiten brunn, and Schwarzenberg in Saxony, and many places in Bohemia, Hungary, Silesia and other European countries.

The localities of Blende in the United States are very numerous; a few of these only therefore can be indicated. The yellowish-brown foliated variety is found abundantly along with Galena at North and South Hampton, (Mass.); the black Blende occurs at Monroe, (Con.) associated with Wolfram, Tungsten, Native Bismuth and Arsenical Iron; the yellow Blende in transparent crystals is met with occasionally throughout the secondary limestones of New York and Ohio. The Missouri lead mines, and the Perkiomen lead mine near Philadelphia, abound with the present species.

BLOEDITE.

Crystalline. Primary form unknown. Massive: imperfectly foliated, and stalactitic. Fracture uneven.

Color between flesh and brick red.

Taste sharp bitter and astringent. Becomes moist in the air.

1. *Analysis.*

By JOHN.

Sulphate of soda . . .	33·34
Sulphate of magnesia . . .	36·66
Sulphate of manganese . . .	0·33
Sulphate of iron . . .	0·34
Chloride of sodium . . .	0·33
Water	22·00

Blue Malachite.

2. It is found in the salt mines of Ischel in Lower Austria.

3. The foregoing description is too inadequate to pronounce upon the pecific character of Bloedite. If it shall prove to be a new species, it vill probably take its systematic place within the genus Glauber-Salt.

4. Under this mineral must be included the *Sulphate of soda and nagnesia of Schemnitz*, which occurs in little crystalline fibres or ieedles, that appear to be rhombic prisms. It is not efflorescent like he Glauber-Salt.

According to BEUDANT, it contains

Sulphuric acid	44·7
Soda	17·6
Magnesia	11·4
Water	25·4
Earthy matter	0·9

5. The *Reussine* of KARSTEN may also be introduced here, until omething further is determined respecting its properties. It occurs in ix-sided acicular crystals, which probably come from a rhombic prism: lso in flakes. Fracture conchoidal. Taste bitter, astringent. It consists of

Sulphate of soda . . .	66·04
Sulphate of magnesia . . .	31·35
Sulphate of lime . . .	0·42
Chloride of magnesium . .	2·19

According to BEUDANT, the Reussine is a mixed mineral, consisting f effloresced Glauber-Salt and small crystalline particles of the double alt of sulphate of soda and magnesia.

BLUE MALACHITE. Azure Copper-Baryte.

Primary form. Oblique rhombic prism. M on M′ =)8° 50′.

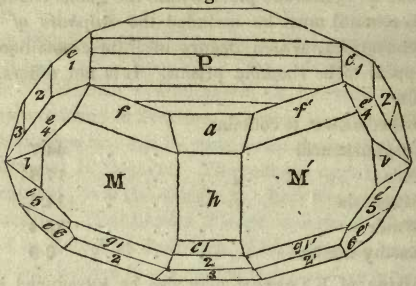
Secondary forms.

1. Primary form. 2. Primary form, having the obtuse erminal edges replaced by single planes. (fig. 95. P. I.) 3. Primary form, having both the obtuse and acute termiıal edges replaced by single planes. 4. Form 2d, with he oblique edges of the prisms replaced by tangent planes. 5. Form 2d, with the lateral solid angles replaced by sin-

Blue Malachite.

gle planes. 6. Form 4th, with lateral solid angles replaced by single planes.

Fig. 68.



P on M or M′	.	91°	30′	M on $g1$ or M′ on $g'1$		142	56
M on M	.	98	50	M on $g2$ or M′ on $g'2$		131	4
P on a	.	135	15	M on h or M′ on h'		139	15
P on $e1$ or $e'1$	.	149	20	M on l or M′ on l'		179	26
P on $e2$ or $e'2$	.	138	12	a on f or f'	.	139	30
P on $e3$ or $e'3$	.	119	30	a on h	.	136	45
P on $e4$ or $e'4$	.	115	30	$e1$ on $e2$	.	169	2
P on f or f'	.	112	15	$e1$ on $e4$	.	141	6
P on h	.	92	15	$e1$ on f	.	129	00
M or M′ on a	.	123	40	$e3$ on $e3'$ over P	.	120	30
M on $e1$ or M′ on $e'1$		111	5	$e3$ on $e5$	.	157	5
M on $e2$ or M′ on $e'2$		116	55	$g1$ on $g2$	.	168	15
M on $e4$ or M′ on $e'4$		149	5	$g1$ on $e6$	.	164	24
M on $e5$ or M′ on $e'5$		156	5	h on $c1$	.	154	4
M on $e6$ or M′ on $e'6$		138	30	h on $c2$	.	134	55
M on f or M on f'		159	50	h on $c3$	.	115	00

PHILLIPS.

Cleavage parallel to M and M′ perfect; parallel to P very difficult. Cleavage may be effected also parallel with both diagonals of the primary form.

Surface of P striated in the direction of the longer diagonal.

Lustre vitreous, almost adamantine. Color various shades of azure-blue, passing into blackish blue and berlin-blue. Streak blue, lighter than the color. Transparent... translucent on the edges.

Blue Malachite.

Brittle. Hardness = 3·5 ... 4·0. Sp. gr. = 3·831, crystals from Chessy.

Compound Varieties. Globular, reniform, botryoidal, stalactitic shapes, implanted and imbedded; surface drusy and rough; composition columnar, more or less perfect and distinct, faces of composition rough. Massive: composition columnar, more rarely granular. Sometimes in an earthy state.

1. Blue Malachite is soluble with effervescence in nitric acid, becomes black if exposed alone to high degrees of temperature, melts upon charcoal, and colors glass of borax green in the oxidating flame.

2. *Analysis.*

	By Klaproth.	By Vauquelin.
Copper	56·00	56·00
Oxygen	14·00	12·50
Carbonic acid	24·00	25·00
Water	6·00	6·50

3. It is met with in veins and beds, included in rocks of different ages. It is generally accompanied by Green Malachite and some other ores of copper. Occasionally it is so intimately connected with Green Malachite, that crystals of the form of the Blue Malachite consist entirely, or at least with only the exception of a thin film on the surface of the delicate green fibres, of Green Malachite. It is often engaged in ochrey varieties of Limonite, and associated with White Lead-ore, Galena and Cobalt-bloom.

4. The most beautifully crystallized varieties are found in a bed in secondary mountains at Chessy near Lyons in France. Fine crystals are brought from Siberia. Very delicate, but small crystals, are found at Oravitza in the Bannat. Blue Malachite occurs also in Thuringia, Hessia, the Hartz, Silesia, Tyrol, Spain, Chili, Peru, and at several places in England and Scotland.

The United States afford no very interesting deposits of this species. The best specimens are found in Pennsylvania at the Perkiomen lead mine, where it occurs in small crystals along with Galena, Blende and White Lead-Ore.

Blue Spar.

BLUE SPAR. Prismatoidal Azure-Spar. Mohs.

Primary form. Doubly oblique prism? of unknown dimensions.

Cleavage indistinct, sometimes pretty obvious in one direction, with traces in other directions, making oblique angles with the easily observed cleavage. Massive. Composition granular, often in large individuals; strongly coherent. Fracture uneven, often splintery.

Lustre vitreous, slightly inclining to pearly upon faces of cleavage. Color smalt-blue, inclining sometimes to white and green. Streak white. Translucent on the edges, often nearly opake.

Brittle. Hardness = 5·5 . . . 6·0. Sp. gr. = 3·024.

1. Before the blow-pipe it loses its color, but does not melt. It is slowly and with difficulty dissolved in borax. With boracic acid and iron-wire, it yields a globule of phosphuret of iron.

2. *Analysis.*

By R. Brandes.

Phosphoric acid . . .	43·32
Silica . . .	6·50
Alumina . . .	34·50
Magnesia . . .	13·56
Lime . . .	0·48
Protoxide of iron . . .	0·80
Water . . .	0·50

3. It occurs in masses, sometimes six or eight inches over; also in large indistinct crystals imbedded in Quartz and mixed with Mica. The rock embracing it, however, has no where been found in place.

4. It is found in the valley of Freschnitz near Krieglach, on the Mürz in Upper Stiria; also at Therenberg at the foot of the Wechsel mountain in Lower Austria.

5. The near agreement of Blue Spar with Sodalite in hardness and specific gravity, and the want of certainty in our knowledge respecting the system of crystallization to which Blue Spar belongs, render it possible that the two substances may hereafter be shown to be identical.

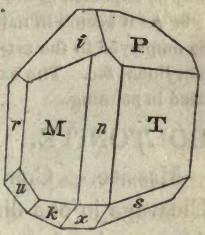
BLUE VITRIOL. Tetarto-Prismatic Vitriol-Salt. Mohs.

Primary form. Doubly oblique prism. P on M 127° 30′. P on T 108°. M on T 123° 10′.

Secondary form.

M on T	-	-	123°	10′
r on M	-	-	126	40
r on T	-	-	110	10
r on *n*	-	-	100	41
r on P	-	-	103	27
n on P	-	-	120	50
P on T	-	-	127	40
i on *r*	-	-	139	13
K on *n*	-	-	109	38
K on *r*	-	-	114	57
s on *n*	-	-	92	26
s on *r*	-	-	139	43

Fig. 69.



Cleavage very imperfect. Fracture conchoidal. Surface: the faces *n* commonly deeply striated parallel to their edges of combination with M and T, which faces are also sometimes striated, though not so generally as *n*.

Lustre vitreous. Color sky-blue, in different shades, commonly deep. Streak white. Semi-transparent ... translucent.

Rather brittle. Hardness = 2·5. Sp. gr. = 2·213.

Taste astringent and metallic.

1. It is easily soluble in water, and gives a blue solution: a polished surface of iron when immersed in this solution is covered with a film of metallic copper.

2. *Analysis.*

By Berzelius.

Oxide of copper . . .	32·13
Sulphuric acid . . .	31·57
Water . . .	36·30

3. Blue Vitriol owes is existence to the decomposition of Copper Pyrites; and is found dissolved in water issuing from mines, and which has received the name of *Water of Cementation*. From this, it deposits itself spontaneously in certain places, and presents itself in large masses, occasionally associated with other ores.

4. Its chief localities are the Rammelsberg near Goslar, Neusohl in Hungary, Anglesey in the Pary's mine, Cornwall at the Consolidated mines, and at the copper mines in Wicklow, Ireland. Its occurrence may be expected at the copperas mine in Stafford, (Vt.)

5. As it occurs in nature, it requires first to be purified, before it can be employed in the arts, where it is used in dyeing, in printing of cotton, linen, &c. The oxide of copper, separated from its acid, is likewise used in painting.

BOLTONITE. Parachrose Tabular-Spar.

Massive. Composition granular: individuals large. Cleavage in one direction pretty distinct, in two others oblique to the first, indistinct, but affording indications of a doubly oblique prism for the primary form. Fracture uneven or small conchoidal.

Lustre vitreous. Color bluish grey, yellowish grey, wax yellow to yellowish white. The darker colors change to yellow on exposure to the weather. Streak white. Transparent or translucent.

Hardness = 5·0 . . . 6·0. Sp. gr. = 2·8 . . . 2·9.

1. This mineral when first discovered was regarded as Pyrallolite. It is believed to be identical with the substance described by Dr. Thomson, (Ann. Lyc. Nat. Hist. of N. York, Vol. III. p. 50,) under the name of Bisilicate of Magnesia; and accordingly the analysis there given is here quoted.

2. Alone before the blow-pipe, it becomes white and transparent, but does not melt. With borax, it dissolves slowly into a transparent glass.

3. *Analysis.*

By Thomson.

Silica	56·64
Magnesia	36·52
Alumina	6·07
Protoxide of iron	2·46

4. Boltonite occurs thickly disseminated through white limestone, associated occasionally with Petalite.

5. It is found abundantly at Bolton, (Mass.) and has also been detected in the neighboring quarries of Boxborough and Littleton.

Bombite.

Massive: composition impalpable.

Color bluish black.

Hardness = 7·5.

1. Fusible before the blow-pipe with ebullition into a yellowish glass.

2. *Analysis.*

By Laugier.

Silica	50·0
Alumina	10·5
Oxide of iron	25·0
Magnesia	3·5
Lime	0·5
Carbon	3·0
Sulphur	0·3

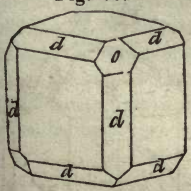
3. Its geological situation is unknown. It has been found only in Bombay. It appears to be a variety of flinty-slate.

BORACITE. Tetrahedral Boracite. Mohs.

Primary form. Cube.

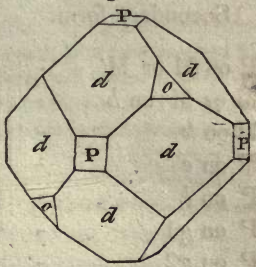
Secondary forms.

Fig. 70.



Segeberg Holstein.

Fig. 71.



Lüneberg.

Cleavage, traces parallel to the faces of the octahedron. Fracture conchoidal, uneven.

Boracite—Borax.

Lustre vitreous, inclining to adamantine. Color white, inclining to grey, yellow and green. Streak white. Semi-transparent, translucent.

Hardness = 7·0. Sp. gr. = 2·974 of an isolated crystal.

1. Before the blow-pipe, on charcoal, it intumesces, and melts into a glassy globule, which becomes white and opake on cooling. It is electric by heat, four alternating terminal points of its cubic axes being positive, and those which are opposite to them, negative.

2. *Analysis.*
By Pfaff.

Boracic acid	54·55
Magnesia	30·68
Oxide of iron	0·57
Silica	2·27

3. Boracite is found in remarkably distinct crystals, about the size of a pea and under, imbedded in compound varieties of Gypsum, and rarely in Anhydrite.

4. The only known localities are Lüneberg in Brunswick and Segeberg in Holstein.

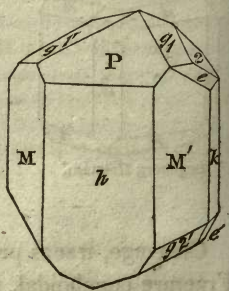
BORAX. Prismatic Borax-Salt. Mohs.

Primary form. Oblique rhombic prism. M on M′ 93° 30′.

Secondary form.

P on M or M′	-	101°	30′
M or M′ on *h*	-	133	20
M on *k*	-	136	45
M on *e*	-	138	12
P on *h*	-	106	30
P on *g*1	-	139	15
P on *g*2	-	115	30
P on *e*	-	114	28
e on *g*2	-	141	52

Fig. 72.



Cleavage parallel to M and M′ perfect, also to both the diagonals of the primary form. Fracture conchoidal.

Lustre resinous. Color white, inclining to grey and green. Streak white. Transparent . . . translucent.

Rather brittle. Hardness = 2·0 . . . 2·5. Sp. gr. = 1·716. Taste sweetish alkaline, feeble.

1. It is soluble in water; the solution changes vegetable blues to green. It intumesces before the blow-pipe, and then melts into a transparent globule.

2. *Analysis.*

Soda	16·7
Boracic acid	36·4
Water	46·9

3. Borax occurs in different districts of Persia and Thibet, where it is found on the surface of the soil, in the vicinity, and sometimes at the bottom, of several lakes, and in a state of solution in the waters of mineral wells. It is found also in Ceylon and at Potosi.

4. The natural salt is employed in manufacturing the artificial one by the addition of a greater quantity of soda. The artificial salt is made use of as a flux, in the production of imitation gems, and in the process of soldering.

5. The natural historical properties above described apply to the manufactured salt: concerning the natural salt but little is known, although perfect crystals of the form here figured are sometimes found among it. In general, it is understood, that it is found mingled up with Common Salt and some excess of boracic acid. The locality in Thibet, which is 15 days from Tisvolumbo, the capital, is a lake supplied by springs, the waters of which contain both borax and common salt. The edges and shallows of this lake are covered with a stratum of Borax, which is dug up from time to time, and the holes thus made are gradually filled by a fresh deposition.

BORNITE. Bismuthic Polypoione-Glance.

Primary form. Rhomboid. Angles not determined.

Cleavage perfect parallel with the primary form.

Lustre metallic. Color pale steel-grey.

Elastic. Not particularly sectile. Soft. Sp. gr. = 8·0.

1. Before the blow-pipe it melts very easily into a globule, that can be entirely volatilized, during which the supporting charcoal is covered with yellow oxide. If dissolved in the state of powder in nitric acid, a precipitate of sulphur is formed.

2. *Analysis.*

	By KLAPROTH.	By WEHLE.
Bismuth	95·01	61·15
Sulphur	5·00	2·33
Tellurium		29·74
Silver		2·07

3. It has been found at Deutsch-Pilsen in Hungary, accompanied by several species of the genus Lime Haloide, Iron Pyrites, &c.

4. Other varieties have been examined from different localities, which require to be mentioned in this place. One from Hungary, for example, has the following properties:

It occurs in imbedded masses, having a general resemblance to 3 and 6 sided prisms. Cleavage perfect in the direction of the bases. Fracture imperfectly conchoidal, uneven, scarcely perceptible. Lustre metallic. Color intermediate between tin-white and steel-grey. Streak unchanged or rather darker; its place becomes shining in the mineral. Opake. Very sectile. Thin laminæ perfectly flexible. Hardness = 1·5. Sp. gr. = 7·408. Before the blow-pipe it gives the reactions of sulphur, tellurium and bismuth. It occurs accompanied by Native Gold and Yellow Copper Pyrites, imbedded in Quartz, at Schemnitz. It contains according to WEHLE,

Bismuth	59 84
Tellurium	35·24
Sulphur	4·92

5. Another variety, examined by BERZELIUS, which had been communicated to him by WEISS of Berlin, was found to contain only tellurium and bismuth.

BOTRYOGENE. Paratomous Vitriol-Salt.

Primary form. Oblique rhombic prism. M on M = 119° 56′.

Cleavage distinct in the direction of M and M′.

Lustre vitreous. Color hyacinth-red. Streak yellow and shining. Translucent.

Hardness $=2{\cdot}0 \ldots 2{\cdot}5$. Sp. gr. $=2{\cdot}039$.

Compound Varieties. Reniform and botryoidal shapes; the individuals are often regularly terminated at the surface of these shapes. Color ochre-yellow.

1. Before the blow-pipe, in a glass tube, it intumesces, and gives off water, leaving a reddish yellow earth behind. It is very slowly soluble in water, to which it imparts a much more feebly astringent taste than sulphate of iron.

2. *Analysis.*

By Berzelius.

Sulphate of iron . . .	48·3
Sulphate of magnesia . . .	20·8
Water . . .	30·9

3. It is found coating Gypsum and Iron Pyrites, associated with Epsom salt and Copperas in the great copper mine at Fahlun.

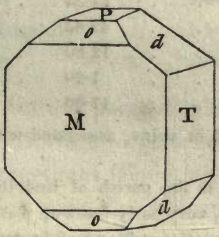
Botryolite. (See *Datholite.*)

BOURNONITE. Diprismatic Copper-Glance. Mohs.

Primary form. Right rectangular prism.

Secondary forms.

Fig. 73.



P on *d*	- - -	93°	40′
P on *o*	- - -	87	8

Cleavage distinct parallel with M and T, and with both diagonals of the prism. Fracture conchoidal, uneven.

Bournonite.

Surface nearly equal, often highly smooth and splendent: longitudinal striæ sometimes visible on the secondary planes, replacing the lateral edges of the prism.

Lustre metallic. Color steel grey, inclining to blackish lead grey or iron black, according to the physical quality of the surface. Streak unchanged.

Brittle. Hardness $=2{\cdot}5 \ldots 3{\cdot}0$. Sp. gr. $=5{\cdot}763$.

Compound Varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel to M, or the broader face of the primary form. The individuals are generally continued beyond the face of composition. The axes of the individuals cross each other at angles of 93° 40′ and 86° 20′. Massive: composition granular; individuals strongly connected.

1. Before the blow-pipe, it generally decrepitates, emits a white sulphureous vapor; after which there remains a black globule, consisting of a crust of sulphuret of lead, within which is a mass of copper. It is easily soluble in heated nitric acid.

2. *Analysis.*

	By Hatchett.	By Klaproth.
Antimony	24·23	20·769
Lead	42·62	42·50
Copper	12 80	11·75
Iron	1·20	5·00
Sulphur	17·00	18·00

3. Bournonite is found in veins, associated with Stibine, Galena, and Blende.

4. It was first found in the parish of Endellion, Cornwall, at Huel Boys. Another locality, very early known, was Kapnik in Transylvania. It is now known to exist at Neudorf, in Anhalt, in large and magnificent crystals; also at Andreasberg in the Hartz. Still other deposits of this ore are Braünsdorf in Saxony, Neusohl in Hungary, and Offenbanya in Transylvania.

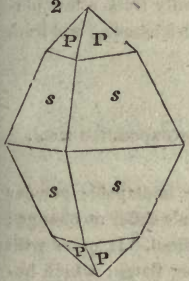
BRAUNITE. Brachytypous Manganese-Ore. Haidinger.

Primary form. Octahedron with a square base. P on P over the base, 108° 39′.

Secondary forms.

1. Primary form, with the summits replaced by tangent planes. Wunsiedel, Bayreuth.

Fig. 75.

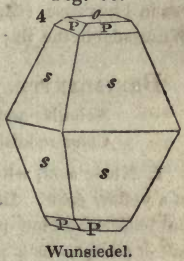


Elgersburg.

Fig. 74.

St. Marcel, Piedmont.

Fig. 76.



Wunsiedel.

s on *s* over the summit	-	96° 33′
s on *s* at the base	-	140° 30′
P on *x* and *x*, alternately	-	144° 4′ and 128° 17′
x on *x* at the base	-	154° 25′

Cleavage very distinct parallel with the primary faces. Fracture uneven. Surface *o* possesses less lustre than P, but is even, and sometimes faintly streaked parallel to the edges of combination with P. Primary faces often a little rounded; faces *s* uneven, rough, and horizontally streaked; faces *x* smooth and even.

Lustre imperfectly metallic. Color dark brownish black. Streak of the same color.

Brittle. Hardness = 6·0 . . . 6·5. Sp. gr. = 4·818.

Compound Varieties. Massive: composition granular individuals strongly coherent.

1. *Analysis.*
By TURNER.

Protoxide of manganese . . .	86·940
Oxygen	9·851
Water	0·949
Baryta	2·260
Silica	a trace.

2. It is yet a rare mineral, having been brought only from a few places in Thuringia, (Elgersburg, Ehrenstock and Friedrichsrode,) and from Wunsiedel in the Bayreuth.

BREISLAKITE.

Acicular and capillary crystals; bent and grouped like wool. Color reddish, or chesnut brown.

1. Nitric acid, when heated, reduces it to a most impalpable powder of a yellow color. In the flame of a lamp, the crystals suffer no change; but before the blow-pipe they melt into a black enamel. It gives with salt of phosphorus a green globule in the oxidating flame, which becomes red in the reducing flame of the blow-pipe, thus indicating a considerable quantity of copper.

2. *Analysis.* Dr. WOLLASTON is said to have made a chemical examination of this species; the result of which was, that it consisted of silica, alumina, and a little iron.

3. Breislakite lines the small cavities in the lava of Scalla, where it is accompanied by Atacamite and Nepheline. It is also found under similar circumstances in the lava of Olebano, near Pozzuoli.

BREUNERITE. (See *Rhomb-Spar.*)

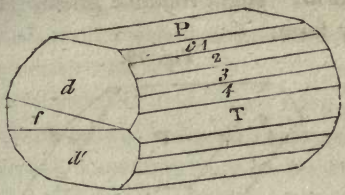
BREWSTERITE. Polyprismatic Kouphone-Spar.

Primary form. Right oblique angled prism. M on T = 93° 40′.

Brewsterite.

Secondary form.

Fig. 77.



P on *d*	-	93°	50′	P on *c*4	-	92° 00′
P on *c*1	-	119	30	*d* on *c*2	-	95 00
P on *c*2	-	114	30	*d* on *d*′	-	175 00
P on *c*3	-	112	00	(172° HAIDINGER.)		

Cleavage, perfect parallel to P, traces parallel to T. Fracture uneven.

Faces slightly streaked parallel to their common intersections.

Lustre vitreous, pearly upon P. Color white, inclining to yellow and grey. Transparent . . . translucent.

Hardness = 5·0 . . . 5·5. Sp. gr. = 2·12 . . . 2·20.

1. Before the blow-pipe, it loses first its water and becomes opake, then it froths and swells up, but is with difficulty fusible. It gives a skeleton of silica with salt of phosphorus.

2. *Analysis.*

By THOMSON.

Silica - - - -	58·800
Alumina - - - -	18 912
Lime - - - -	12·384
Potash - - - -	1·500
Water - - - -	11·700
	103·296.

(The excess of 3¼ p. c. was attributed to soda employed in the analysis.)

3. It is found lining cavities in a granitic rock at Strontian, in Argyllshire in Scotland.

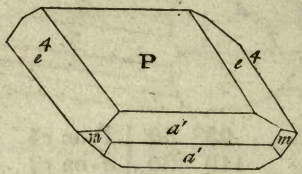
BRIGHT WHITE COBALT. (See *Smaltine*.)

BROCHANTITE. Prismatoidal Vitriol-Salt.

Primary form. Right rhombic prism. M on M′ 117°.

Secondary form.

Fig. 78.



Cleavage; traces parallel to *m*. Surface *m* blackish and dull, the remaining faces smooth and shining.

Color emerald green. Transparent.

Hardness =3·5 . . . 4·0, nearly. Sp. gr. = 3·7 . . . 3·8.

1. *Analysis.*
By MAGNUS.

Sulphuric acid . . .	17·426
Oxide of copper . . .	66·935
Water . . .	11·917
Oxide of tin . . .	3·145
Oxide of lead . . .	1·048

2. It is found in small, but well defined crystals, on Green Malachite, at Ekatherinburg, Siberia; also in a pulverulent form in France and Hungary.

BRONZITE. Hemi-prismatic Schiller-Spar. MOHS.

Primary form. Oblique rhombic prism. M on M′ 94°. C.

Cleavage; parallel with P very perfect, though in general a little curved; and sometimes having almost imperceptible layers of Calcareous Spar interposed between the laminæ. In the direction of M and M′ less distinct; with traces also in to the diagonals of the cleavage form. Fracture uneven and splintery.

Bronzite.

Lustre metallic pearly upon P; for the rest, low degrees of an imperfectly vitreous lustre. Color dirty shades of leek green and blackish green; also liver-brown, hair-brown and clove-brown, greenish and ash-grey. These colors are heightened by a metalloidal appearance upon P, and often incline to pinchbeck-brown. Streak corresponding to the color. Translucent, sometimes only on the edges.

Rather sectile. Hardness = 4·0 ... 5·0. Sp. gr. = 3·251, a brown variety from Bayreuth.

Compound Varieties. Massive: composition granular, of various sizes of individuals, strongly connected.

1. By the action of fire it assumes a lighter color, and loses its water; but is by itself infusible before the blow-pipe.

2. *Analysis.*

By KOHLER.

	From Stempel near Marburg.	Ulten Valley, Tyrol.
Silica	57·193	56·813
Magnesia	32·669	29·677
Lime	1·299	2·195
Protoxide of iron	7·461	8·464
Protoxide of manganese	0·349	0·616
Alumina	0·698	2·068
Water	0 631	0 217

3. Bronzite is found in imbedded crystalline particles, either simple or compound, in serpentine and greenstone rocks. It sometimes presents itself in beds in the serpentine formation, mingled with massive Hornblende.

4. It is found in considerable quantity in and near the Gulsen mountain, in the vicinity of Kraubat in Stiria, where it forms beds in serpentine. It occurs near Hof in Bayreuth, and probably at the Baste in the Hartz, in the Bacher mountain in Lower Stiria, near Marburg, the Ulten Valley in the Tyrol, at Lizard district in Cornwall, and in various other countries.

A variety of this species has been discovered within a few years at Amity, in Orange county, (N.Y.) It occurs in limestone beds, which

are associated with serpentine; and is immediately connected with massive and crystallized Hornblende, Augite, and Plumbago. Its color is a fine reddish brown, attended with a metallic lustre. It has been analyzed by Mr. T. G. CLEMSON, who, under the impression of its being a new species, has bestowed upon it the name of *Seybertite*, after the American analyst, Mr. SEYBERT. But its identity in form, hardness and sp. gr. with Bronzite, does not appear to justify the attempted distinction. Mr. CLEMSON found it to consist of

Alumina	37·60
Magnesia	24·30
Lime	10·70
Silica	17·00
Protoxide of iron	5·00
Water	3·60

BROOKITE. Diatomous Eruthrone-Ore.

Primary form. Right rhombic prism. M on M′ 100°.

Secondary form. Low hexagonal prism.

Cleavage parallel with the shorter diagonal.

Lustre metallic adamantine. Color hair-brown, passing into a deep orange-yellow, and some reddish tints. Streak yellowish white. Translucent . . . opake, the brighter colors are observed by transmitted light.

Brittle. Hardness = 5·5 . . . 6·0.

1. It contains oxide of titanium, with traces of iron and manganese; but has not yet been analyzed. The first varieties were noticed among the minerals accompanying Anatase from Dauphiny; but much finer crystals, some of them half an inch in diameter, have lately been found at Snowdon, in Wales. In both places they are accompanied by Quartz; and in Dauphiny, besides Anatase, it is attended by Crichtonite and Albite.

BROWN IRON ORE. (See *Limonite*.)

BRUCITE. Hemi-prismatic Tourmaline.

Primary form. Oblique rhombic prism. M on M′ 112°? from cleavage.

Brucite.

Secondary form. In very short prisms, apparently having all the edges and solid angles replaced so as to obliterate the lateral and terminal planes. The secondary terminal planes much rounded; the most distinct crystals affording angles over the summit of between 130 and 140° with the common goniometer.

Cleavage parallel with M, M′ indistinct; that parallel with P very indistinct.

Lustre vitreous, to resinous. Color yellow, brown and red. Transparent . . . translucent.

Hardness = 6·5. Sp. gr. = 3·199.

Compound Varieties. Massive: composition granular, of various sizes of individuals.

1. It is fused with difficulty before the blow-pipe. It loses its color almost entirely, becomes opake, and shows traces of fusion on very thin edges. The brown and grey varieties act upon the magnetic needle, where the double magnetism is employed.

2. *Analysis.*

	By D'Ohsson.	By Seybert.
Silica	38·00	32·666
Magnesia	54·00	54·000
Oxide of iron	5·10	0·000
Peroxide of iron	0·00	2·333
Alumina	1·50	0·000
Potash	0·86	0·000
Fluoric acid	0·00	4·086
Water	0·00	1·000

3. Brucite is found disseminated through Calcareous Spar, associated with Hornblende, Spinel and Mica.

4. It occurs at Ersby in the parish of Pargas in Finland, where it was first discovered: but its most abundant localities are in the U. States, in the adjoining counties of Sussex, (New-Jersey,) and Orange, (New York,) where it exists under the circumstances above described, and also accompanied by Spinel, and rarely by Pyroxene and Bronzite. In Sussex county, it is particularly abundant at Newton; and in Orange county, at Amity and Edenville.

BUCHOLZITE. Prismatoidal Axinite.

Primary form. Oblique rhombic prism. M on M′ 99° 30′? Only the primary crystal with curved faces has been observed; and this without regular terminations.

Cleavage parallel with the longer diagonal perfect; parallel with P and M, visible, but indistinct. Fracture conchoidal to uneven.

Lustre vitreous. Color shades of greyish white and hair-brown; sometimes presenting a metalloidal appearance upon M. Bluish opalescence rarely observed upon cleavage faces parallel to M. Streak white. Translucent.

Brittle. Hardness = 7·5 ... 8·0. Sp. gr. = 3·2.

Compound Varieties. Massive: composition columnar, consisting of delicate, straight or slightly curvilinear individuals, strongly coherent, and sometimes nearly impalpable. Viewed in the longitudinal fracture the lustre is silky; but in the cross fracture, which is even and splintery, it is resinous.

1. The identity of *Sillimanite* with the present species appears probable, not only from the resemblance in the properties of hardness and specific gravity, but in that of crystalline structure; the perfect crystals of the former often becoming compound and fibrous at one end; and the less impalpable masses of Bucholzite, exhibiting crystals which afford the brilliant cleavage surfaces parallel with the longer diagonal of Sillimanite. The disagreement in chemical composition, it is presumed will disappear on searching for zirconia in future analyses of Bucholzite.

Before the blow-pipe, alone, and with borax, infusible.

2. *Analysis.*

	By Bowen, from Chester, Ct.	By Muir, from Chester, Ct.	By Brandes, from Tyrol.	By Hilton & Mitchell, fr. Chester, Pen.
Silica	42·666	38·670	46·00	46·40
Alumina	54·111	35·106	50·00	52·92
Zirconia	0·000	18·510	0·00	0·00
Oxide of iron	1·999	7·216	2·50	a trace.
Water	0 510	0·000	0·00	0·00
Potash	0·000	0·000	1·50	0·00

3. The distinctly crystallized variety, or Sillimanite, occurs in veins of Quartz at Chester, (Conn.) in a quarry of gneiss. The compactly fibrous variety was discovered originally in the Tyrol. It exists in the United States, at Chester, (Penn.) near Philadelphia, and at Humphreysville, (Conn.)

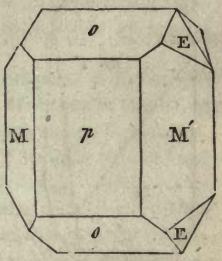
Bucklandite.

Primary form. Oblique rhombic prism? M on M 109° 20′.

Secondary form.

b on M or M′	103°	56′
M on M′	70	40
M on *p*	125	20
b on *p*	114	55
b on *e*	121	30
o on *o*	99	41
o on *e*′	95	40
M on *e*′	160	24

Fig. 79.



Cleavage not observable. Color dark brown, nearly black. Opake. It appears to be harder than Pyroxene.

1. It was discovered in small crystals on a specimen from Neskiel mine, near Arendal in Norway, where it occurs with black Hornblende, Scapolite and Calcareous Spar. It resembles Pyroxene.

2. It is not sufficiently described to settle the question of its specific character.

BUSTAMITE. Staphyline Parachrose-Baryte.

Massive: in reniform and botryoidal groupes.

Color, light grey, passing into a greenish or reddish color. Nearly opake.

Hardness = 6·0 . . . 6·5. Sp. gr. = 3·1 . . . 3·3.

1. *Analysis.*

By Dumas.

Silica	48·90
Protoxide of manganese	36·06
Lime	14·57
Protoxide of iron	0·81

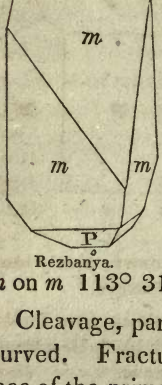
2. It occurs at Real de Minas in Mexico.

CALAMINE. Rhombohedral Zinc-Baryte Mohs.

Primary form. Rhomboid. P on P′ = 107° 40′.

Secondary forms.

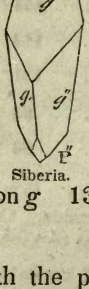
Fig. 80.



Rezbanya.

m on m 113° 31′.

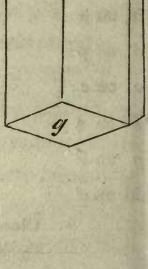
Fig. 81.



Siberia.

g on g 137° 8′

Fig. 82.



Cleavage, parallel with the primary form perfect, often curved. Fracture uneven, imperfectly conchoidal. Surface of the primary faces generally curved, and often rough.

Lustre vitreous, inclining to pearly. Color white, though seldom pure: generally grey, green, or brown. Streak white. Semi-transparent . . . translucent.

Brittle. Hardness = 5·0. Sp. gr. = 4·442.

Compound Varieties. Reniform, botryoidal, stalactitic, and other imitative shapes; surface generally rough, composition columnar. Massive: composition granular, sometimes impalpable; strongly coherent. By decomposition, it becomes friable and earthy. Crystalline coats and pseudomorphoses formed after crystals of Calcareous Spar.

1. Before the blow-pipe it loses its transparency, but is infusible; the carbonic acid is driven off, and the residue acts like pure oxide of zinc. It is soluble in nitric acid with effervescence. It is negatively electrified by friction.

2. *Analysis.*

By SMITHSON.

Oxide of zinc	65·20
Carbonic acid	34·80

3. Calamine is found, often associated with Electric Calamine, in veins and beds belonging to various classes of rocks, but chiefly in those which are calcareous; and they are usually accompanied by ores of lead, copper, iron and zinc.

4. It occurs in the Bannat of Temeswar in Hungary, at Raibel and Bleiberg in Carinthia, at Tarnowitz in Silesia, at Medziana in Poland, at Aix la Chapelle; also in France, and in Leicestershire, Derbyshire, Flintshire, Somersetshire, in England, and at Wanlockhead and Lead hills in Scotland. Calamine exists in the United States in great abundance, in Jefferson county, Missouri, at a lead mine called Valle's Diggings. Other localities of this species less remarkable, are the Perkiomen lead mine, Pennsylvania, and the iron mine at Franklin, New Jersey: at the latter place, however, it only occurs in a pulverulent form, from the decomposition of Red Zinc-Ore.

CALCAREOUS HEAVY SPAR.

This mineral, imperfectly distinguished by BREITHAUPT from Heavy Spar, is described as follows: Crystals, right rhombic prisms, surmounted by pyramids; the lateral planes inclining under angles of 101° 53′. Cleavable parallel with the base with great distinctness, and nearly as much so with the lateral faces of the rhombic prism. Lustre pearly to vitreous. Sp. gr. = 4·02 ... 4·29. Locality is not mentioned.

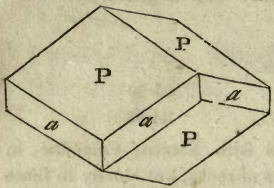
CALCAREOUS SPAR. Rhombohedral Lime Haloide. MOHS.

Primary form. Rhomboid. P on P=105° 5′.

Calcareous Spar.

Secondary forms.

Fig. 83.



Derbyshire and Cumberland.

Fig. 84.

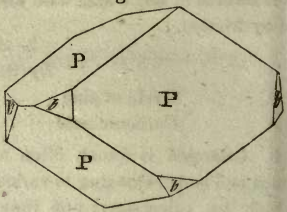


Fig. 85.

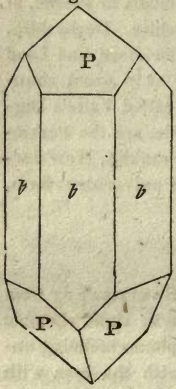
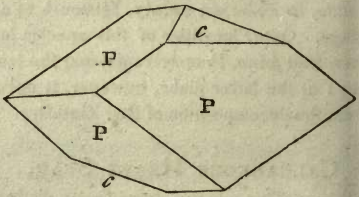
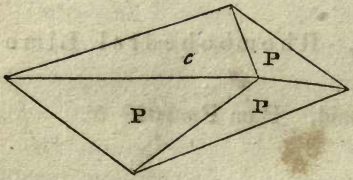


Fig. 86.



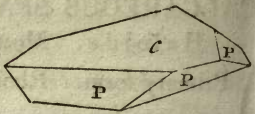
Cadiz, Spain.

Fig. 87.



Hartz.

Fig. 88.



Hartz.

Calcareous Spar.

Fig. 89.

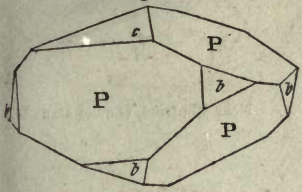
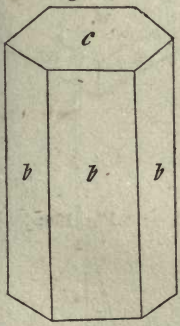


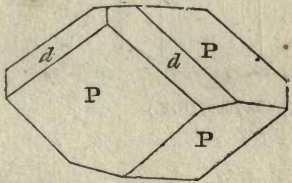
Fig. 90.

Fig. 91.



Hartz, Cumberland and Derbyshire.

Fig. 92.



Dauphine and Derbyshire.

Fig. 93.

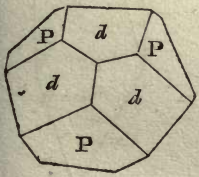
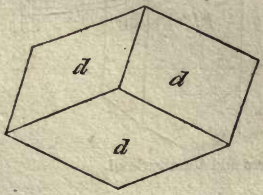


Fig. 94.



Calcareous Spar.

Fig. 95.

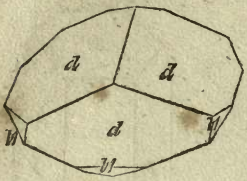
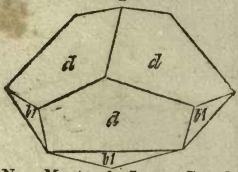
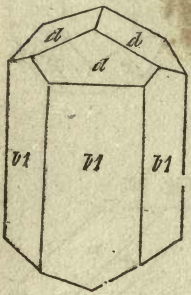


Fig. 96.



Near Montreal, (Lower Canada.)

Fig. 97.



Leyden, (N.Y.)

Fig. 98.

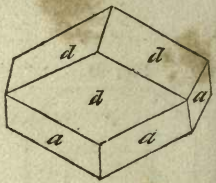


Fig. 100.

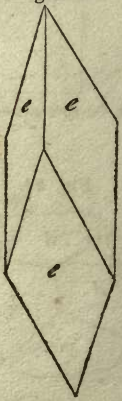
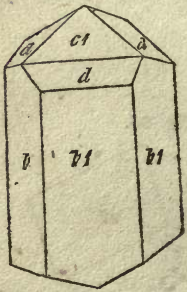


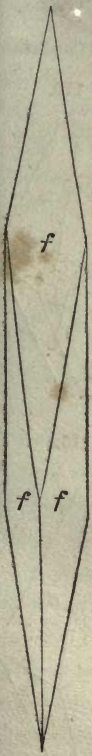
Fig. 99.



Hartz and Cumberland.

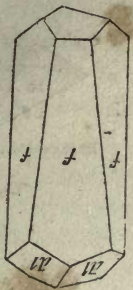
Calcareous Spar.

Fig. 101.



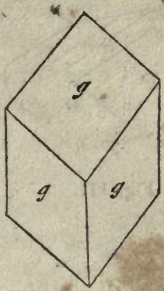
Westmoreland, (England.)

Fig. 102.



Hartz and England.

Fig. 103.



Southbury, (Conn.)

Fig. 104.

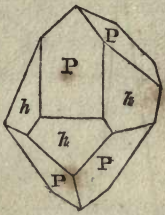


Fig. 105.

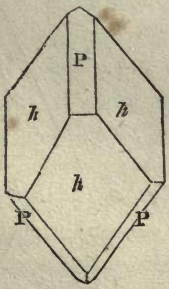


Fig. 106.

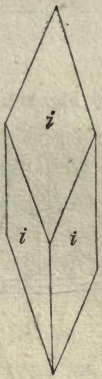
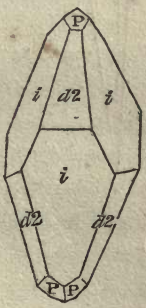


Fig. 107.



Calcareous Spar.

Fig. 108.

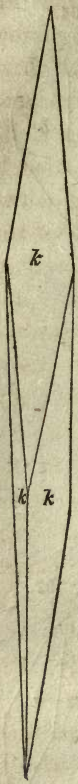


Fig. 109.

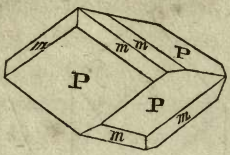
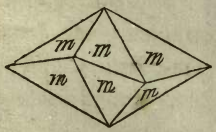


Fig. 110.



Derbyshire and Cumberland.

Fig. 111.

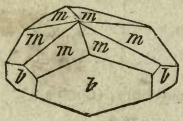


Fig. 112.

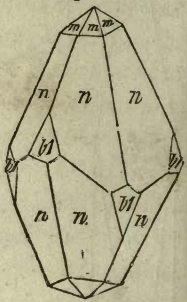


Fig. 113.

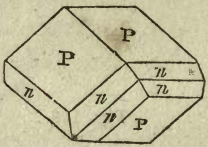


Fig. 114.

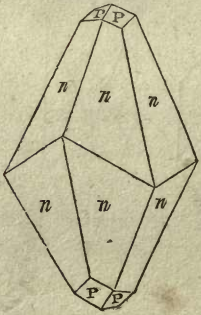
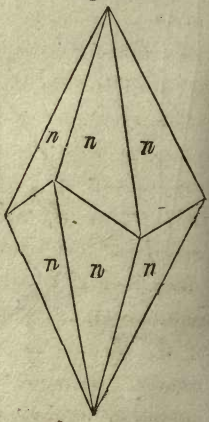


Fig. 115.



Calcareous Spar.

Fig. 83. The primary with its lateral edges replaced by tangent planes, a: P on $a = 135°$. The crystals of this modification differ in the length of the new planes a. Fig. 84. The primary with its lateral angles replaced by tangent planes, b. Fig. 85, has the planes elongated: this is the most common modification of the species. The planes P are often irregularly extended; and sometimes one or two of them are wholly wanting from each extremity of the prism. P on $b = 135°$. Fig. 86. The primary, having its summit replaced by a tangent plane. Fig. 87 and 88, the same, with the new plane more extended: these form the *basées* of Hauy. P on $c = 135°$. The faces c are liable to a pearly lustre. Fig. 89 unites the modifications of Figs. 84 and 86. Fig. 90, the same, with the faces b more extended so as to produce an elongated prism. Fig. 91, the regular hexagonal prism, produced from Fig. 90 by the extension of c: the *prismatique* of Hauy. Occasionally, the prism is reduced in length to a mere table. Hartz. Sometimes this modification is affected by the undue enlargement of certain of the lateral faces, so as to convert it into a trihedral, tetrahedral or pentagonal prism. Fig. 92. Primary, with its upper edges replaced by tangent planes. P on $d = 149° 2'$. Fig. 93, the same, more deeply replaced. Fig. 94, d on $d = 134° 26'$. This is called the equilateral rhomboid: it is the *equiaxe* of Hauy. It is a very abundant form of Calcareous Spar. Fig. 95, the same, having the lateral angles replaced by tangent planes. d on $b1 = 116° 34'$. Figs. 96 and 97, the same, in which $b1$ is variously produced. Fig. 98, the equilateral rhomboid, with its lateral edges replaced by tangent planes. These prisms are sometimes elongated. Fig. 99, the same as Fig. 97,

but having the summit replaced by a tangent plane. *d* on *c*1=153° 26′. Four other rhomboids, of the following dimensions: viz. 115° 42′, 129° 54′, 151° 48′, and 156° 24′, derivable from the primary by tangent replacements of its upper edges, the new planes inclining differently to the vertical axis, undergo many of the modifications above described with respect to the primary and the equilateral rhomboids; but their forms are not common.

In addition to the foregoing rhomboids, Calcareous Spar presents a great variety of acute rhomboids, of which Fig. 100 is one of the most common. It is the *contrastant* of Hauy. Its localities are numerous. This rhomboid goes through the modifications above described; and in addition to them, it occurs having the summits replaced by three new planes: in one instance, the new planes resting upon the rhomboidal planes; and which incline under angles of 105° 5′, being portions of the primary form; and in the other, resting upon the edges and inclining towards the axis. *e* on *e*=65° 41′; Fig. 101, a rhomboid still more acute, *f* on *f*=60° 34′. Fig. 102, the same, with the upper edges replaced by tangent planes; the *contractée* of Hauy. *f* on *d*1=112° 9′ 59″. *d*1 on *d*1=134° 25′ 38″. Fig. 103 is a rhomboid slightly acute. *g* on *g*=87° 48. It approaches the cube in form; and is called by Hauy, the *cuboide*. It is not common. It suffers the same modifications as the last described rhomboid. Figs. 104 and 105 explain the passage of the primary into an acute rhomboid, called the inverted rhomboid, in consequence of its being a complete inversion of the primary rhomboid. P on *h*= 129° 13′ 53″. *h* on *h*=78° 27′ 47″. This form is found undergoing all the modifications above described, and many

others; amounting in all to more than forty. Fig. 106, a still more acute rhomboid, the cleavage of whose crystals takes place at the summits, directly upon the edges. It is the *mixté* of Hauy. i on $i = 63° 44' 55''$. It is common. P on $i = 119° 2' 11''$. Fig. 107 is the same, having the primary planes at the summit, and having the upper edges replaced by the planes $d2$. P on $d2 = 149° 2' 11''$, i on $d2 = 149° 2' 11''$, i on $d'2$ $154° 39' 14''$. Fig. 108 is the most acute of all the rhomboids of Calcareous Spar. It is called the *dilatée* of Hauy. It is not very rare, either perfect, or suffering the modifications above described. k on $k = 60° 24'$. Fig. 109 represents the primary rhomboid having its upper edges replaced by two planes,—the commencement of the dodecahedron with scalene triangular planes, as represented in Fig. 110. m on m over the summit $= 121° 26'$. Fig. 111 has the lateral solid angles replaced by tangent planes; and Fig. 112 has in addition, the upper edges of $b1$ replaced by the planes n, which forms the *soustractive* of Hauy. Numerous other faces, in addition to these, occur in some of the varieties. n on $b1 = 152° 6' 52''$, n on $n = 161° 48' 18''$. Fig. 113 is the primary rhomboid, having its lateral edges replaced by two planes n. It is very common in this condition; and with the new planes more extended, as in Fig. 114, it forms the *binaire* of Hauy; and when they are still more so, as in 115, it forms the *metatastique* of the same author. Fig. 113 undergoes more than one hundred modifications. P on $n = 151° 2' 40''$. n on n over the summit $= 48° 22'$. n on n over the base $= 104° 28' 40''$. n on n over a pyramidal edge $= 144° 20' 26''$. $b1$ on $n = 152° 6' 52''$.

Calcareous Spar.

Cleavage parallel to the primary rhomboid, easily obtained, even and highly perfect. Fracture, perfectly conchoidal, but difficult to be obtained.

Surface generally even: rarely, curved faces appear in certain rhomboids and pyramids.

Lustre vitreous. The lustre of *c* is sometimes pearly. Color white, prevalent. Also different shades of grey, red, green, yellow; all of them pale. Dark brown and black colors owing to foreign admixtures. Streak greyish white. Transparent... translucent; double refraction very considerable, and easily observed.

Brittle. Hardness =3·0. Sp. gr. =2·721, a transparent crystal.

Compound Varieties. Twin-crystals.

Fig. 116.

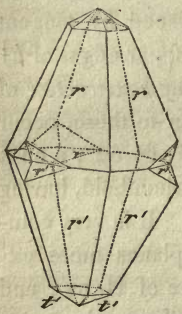


Fig. 117.

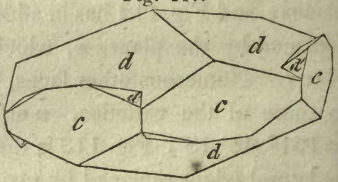


Fig. 118.

Fig. 119.

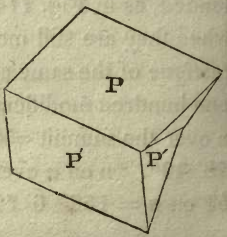


Fig. 120.

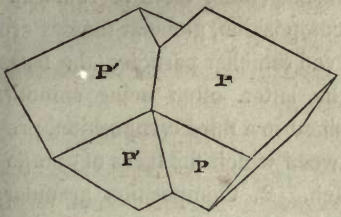
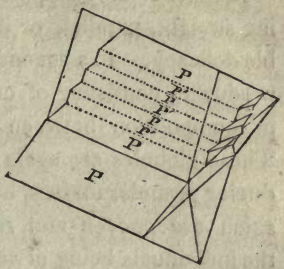


Fig. 121.



In Fig. 116 and 117 the face of composition is perpendicular to the axis of the aggregated crystals; and the angle of Revolution $=60°$. In Fig. 119 the face of composition is represented by the dotted lines in Fig. 118. In Fig. 120 it coincides with a plane passing through its vertical axis: in both, the angle of revolution $= 180°$. The regular composition in faces parallel to the plane indicated in Fig. 118, takes place also in massive varieties; and then more or less thick laminæ of the two individuals alternate with each other, as in Fig. 121. The frequent occurrence of those well known striæ (here delineated) upon the faces of cleavage, parallel to the horizontal diagonal of the rhombs, depends upon this mode of regular composition.

Implanted globules; stalactitic, botryoidal, fructicose shapes: surface uneven, drusy, rough or smooth, composition columnar, more or less distinct, straight diverging, and of various sizes. Stalactitic and botryoidal varieties are often composed a second time of curved lamellar particles, conformably to the surface of the imitative shapes, the faces of composition being uneven and rough, or irregularly streaked in a longitudinal direction.

Calcareous Spar.

Massive: 1. Composition columnar, the individuals being straight, parallel, or diverging, very often of remarkable delicacy. In a second composition, globular masses are produced, consisting of curved lamellar particles, the faces of composition between the latter often being smooth. These globules are again joined in a third composition, producing granular masses, between which the faces of composition are uneven and rough. 2. Composition granular, the individuals being of various sizes, and even impalpable; faces of composition irregularly streaked, uneven and rough. The individuals cohere more or less firmly. If the composition be impalpable, fracture becomes splintery, uneven, flat, conchoidal, or even; on a large scale it is sometimes slaty. The fracture is earthy in those varieties in which the individuals cohere but slightly. 3. Composition lamellar; the indviduals more or less thin, and often bent; face of composition sometimes rough, and possessing a pearly lustre. Globules formed in cavities; plates, of various kinds of composition.

1. The species of Calcareous Spar, as at present regarded by the majority of mineralogists, probably embraces several distinct species, separated from one another by constant differences of form, hardness and specific gravity. An attempt has been made within a few years by BREITHAUPT, to determine, by some of the nicest mineralogical researches of modern times, a number of such species. But as the differences upon which he founds his conclusions are so slight, in comparison with specific differences in general in the mineraal kingdom, it seems most judicious for the present to introduce his results in the form of an appendix to this species, where they will be found given in sufficient detail to enable the mineralogical student to appreciate their value.

The division of Calcareous Spar into several sub-species and varieties, in the older treatises on the science, depends chiefly upon the mode of composition, and upon admixtures and impurities, with which the individuals have been affected in their formation. Of these *Limestone* rep-

resents the greater part of the pure varieties of the species. The simple varieties, and such compound ones in which the individuals are of considerable size, and easily cleavable, have been called *Calcareous Spar;* compound varieties of granular, still discernible individuals, are *granular Limestone*, both comprehended under the head of *foliated Limestone*. If the granular composition disappear, *compact Limestone* is formed; under which denomination also, Oolite or Roestone was included; the roundish grains, however, of the latter, consist of columnar individuals, disposed like the radii of a sphere, and frequently showing distinct traces of cleavage. *Common fibrous Limestone* is produced by columnar composition in massive varieties; the *fibrous Calcsinter* by the same, but appearing in various imitative shapes. *Pea-stone* or *Pisolite* consists of diverging columnar individuals, collected into curved lamellar ones, forming globular masses, which are again agglutinated by a calcareous cement. Each of the globules generally contains a grain of sand, which is of Quartz or Feldspar. Compact limestone passes into *Chalk*, if the individuals are more loosely connected with each other, so that the whole assumes an earthy appearance; and *Rock milk* or *Agaric mineral* is formed, if the mass contains so many interstices, that it seems to possess but a small degree of specific gravity. *Calcareous tufa*, a recent deposit formed on the surface of the earth, is often cleavable, and thus possesses all the properties of the variety called Calcareous Spar. *Slate-spar* or *Argentine*, is produced by a lamellar composition in massive varieties, in the direction of the face of composition Fig. 119 of twin-crystals, contained in thin parallel layers. *Swinestone*, *Anthracolite*, *Marl* and *Bituminous Limestone*, are impure and mixed varieties, partly of calcareous spar, partly of compact limestone.

The pure varieties of Calcareous Spar are entirely soluble, with effervescence in nitric or muriatic acid. In the common fire they are infusible, but part with carbonic acid, and become converted into quick-lime.

2. *Analysis.*

According to the analyses of several of the first chemists, Calcareous Spar consists of

Lime	- -	56·0 . . . 57·0
Carbonic acid	- -	43 0 . . . 44·0

The varieties very often contain a small portion of oxide of iron, silica, magnesia, alumina, carbon or bitumen.

3. Calcareous Spar rarely enters into the composition of rocks. In most cases, the more considerable masses of it form particular beds in other rocks, or constitute rocks themselves: the latter consist chiefly of

compact limestone; the former of granular limestone. The simple varieties occur in drusy cavities, more frequently in veins than in beds, accompanied with the varieties of different species. Columnar compositions have been observed to form veins by themselves, and a great number of varieties are met with in the cavities of several rocks. Slate spar is generally a product of beds of granular limestone; calcareous tufa and rock-milk, being of a sintery formation, occur upon the surface, and in fissures of limestone rocks, and rock-milk in particular is generally a very pure carbonate of lime. Stalactitic and pisiform varieties are produced by calcareous springs and other waters. The original repository of Anthracolite is not known, it having as yet been found only in large boulders. The impure varieties occur in particular strata, between those of compound varieties of other species. This species is very common in petrifactions, imbedded in compact varieties of the same species.

4. Calcareous Spar is one of the most widely diffused species. Several of its varieties have a considerable share in the constitution of mountains in many countries. This is particularly true in Switzerland, Italy, Carniola, Carinthia, Salzburg, Stiria, and in several parts of the United States. Beds of granular limestone in gneiss and mica slate, abound in all the New England States; also in New York, New Jersey and Pennsylvania; also, of the compact limestone, in Upper and Lower Canada, upon Lake Champlain, and throughout the vast district contained between the Alleghany mountains, the lakes and the Mississippi. Of crystallized varieties, the most remarkable occur in Derbyshire and Cumberland, in the mining districts of Saxony and Bohemia, in the Hartz, in Carinthia, Stiria, Hungary, and France; and in North America, at Bytown, (Lower Canada,) Kingston, (Upper Canada,) Lockport and Leyden, (New York,) and the Silver mines of Mexico. Iceland is the locality of its finest and most transparent varieties, from whence come the best pieces of the doubly refracting spar. The *crystallized sandstone* of Fontainbleau in France, (*Chaux carbonatée quartzifère of* Hauy,) is a variety of calcareous spar, mechanically mixed with sand. When crystallized, it assumes the form of the inverted rhomboid. Argentine occurs in Saxony, Norway and Cornwall, and in the United States at Williamsburg and Southampton, (Mass.,) in the lead veins, as well as in the iron mine of Franconia, (N. H.) Picrolite is found in Carniola, and at Carlsbad in Bohemia. Anthracolite is found in Salzburg. Calcareous Tufa abounds in the States of New York and Ohio, where its formation at the surface of the ground, or in cavities of compact limestone, is constantly progressing. Stalactitic varieties are particularly abundant

in the caves of Virginia and Kentucky. Most of the varieties are so common as to render the mention of their localities unnecessary.

5. Several varieties of Calcareous Spar are usually employed for various purposes, partly depending upon their mechanical, partly upon their chemical composition. Those used in sculpture, and in ornamental architecture, are called *marble;* the more common or coarse varieties are used for the common purpose of building. A peculiar variety of very fine grained, compact limestone, is used for plates in lithography. The best sort is found near Pappenheim and Sohlenhofen in Bavaria. Quick lime is obtained from the calcination of this species. Carbonic acid for chemical purposes, as well as for the impregnation of artificial mineral waters, is obtained from chalk and from marble powder. Chalk is also used for writing and for whitewashing. Calcareous Spar is likewise a valuable addition in several processes of melting ores, and in producing certain kinds of glass.

Appendix to Calcareous Spar.

i. *Archigonal Carbon-Spar.* Breithaupt.

P on P = 105° 0′.
Cleavage parallel to the primary rhomboid, perfect.
Hardness (scale of Breithaupt) = 4·0 . . . 4·25.
Sp. gr. = 2.7348, a cleavable fragment from Neue Hoffnung Gottes at Bräunsdorf, west of Freiberg.
2·7362, a similar variety, but less cleavable.
2·7426, cleavage forms, from Himmelsfürst in Freiberg.
2·7485, cleavage forms, very clear and beautiful, from the Tunge hohé Birke in Freiberg.
2·7500, dull crystalline fragments, from Himmelsfürst.

Other localities of the Archigonal Carbon-Spar at Freiberg, are the Beschert Glück and Himmelfahrt mines. Besides, it occurs at Johann Georgenstadt, at Schneeberg in the Erzgebirge, and at Przibram in Bohemia; and on the whole is a frequently occurring species.

ii. *Kouphone Carbon-Spar.* Breithaupt.

P on P = 105° 2′ 30″.
Cleavage parallel to the primary rhomboid, perfect.
Hardness (scale of Breithaupt) = 3·75.
Sp. gr. = 2·6788, cleavage forms, from Kornial-Hole at Trieste, in mountain limestone.

Color, brick-red, like the Heulandite from Fassa, Tyrol.
Its only locality is Trieste.

iii. *Eugnostic Carbon-Spar.* BREITHAUPT.

P on P = 105° 5′.
Cleavage parallel to the primary rhomboid, very distinct.
Hardness (scale of BREITHAUPT) = 3·75 . . . 4·00.
Sp. gr. = 2·7170, a clear cleavage crystal from Iceland.
2·7171, a clear cleavage crystal, but of a flesh-red color, from Iberg in the Hartz.
2·7177, a clear cleavage crystal, from the same place.
2·7179, a cleavage crystal, from Rotluf in Chemnitz, in the Erzgebirge.
2·7190, a clear crystal, from Ahren in Tyrol.
2·7190, three clear cleavage crystals, from Boiza in Siebenbürgen.
2·7203, cleavage crystal, from a beautiful white Calcareous Spar from Moderstolln, *Schemnitz.*

1. A variety analyzed by STROMEYER, from Iceland, contained

Carbonic acid - - - -	43·70
Lime - - - -	56·15
Oxide of manganese and iron -	0·15

iv. *Polymorphous Carbon-Spar.* BREITHAUPT.

P on P = 105° 8′.
Cleavage parallel to the primary rhomboid very distinct.
Hardness = (scale of BREITHAUPT) = 0·4.
Sp. gr. = 2·7088, locality not known.
2·7089, a cleavage crystal. Maxen at Dresden.
2·7100, a cleavage crystal. Braunsdorf in Tharand.
2·7110, a cleavage crystal, of a pale wine-yellow color, locality unknown.
2·7111, a cleavage crystal, of a pale wine-yellow color, from Derbyshire.
2·7122, a cleavage crystal, milk-white to blue, from Cziklowa in the Bannat.
2·7125, a cleavage crystal, white and transparent, from Stanowski Gorni in Karczowka.
The following varieties probably belong to this species.

Calcareous Spar.

Sp.gr. = 2·7081, milk-white, translucent Calcareous Spar, from Scheibenberg in the Erzgebirge.

2·7084, milk-white, from Krodendorf in the Erzgebirge. Lustre resinous, or oily.

This is the most abundant species of the family; and occurs in formations of nearly every age. A variety from Andreasberg, analyzed by STROMEYER, afforded

Carbonic acid - - -	43·5635
Lime - - -	55 9802
Oxide of manganese and iron -	0·3563
Water - - -	0·1000

v. *Meroxene Carbon-Spar.* BREITHAUPT.

P on P = 105° 11′.

Cleavage perfect parallel with the primary rhomboid.

Hardness (scale of BREITHAUPT) = 4·0.

Sp.gr. = 2·6895, a fragment of a crystal, from Tharaud in Dresden.

2·6903, cleaved from massive variety, associated with Natrolite, from Mariaberg in Aussig, Bohemia.

Most of the zeolitic druses from Iceland are supposed to contain this species.

vi. *Haplotypous Carbon-Spar.* BREITHAUPT.

P on P = 105° 13′ 40″.

Cleavage, less perfect than in the foregoing species.

Hardness (scale of BREITHAUPT) = 4·25.

Sp.gr. = 2·7280, } fragments of crystals of a wine-yellow color,
2·7294, } from the galleries of Verlorne Hoffnung and Neue Hoffnung Gottes at Braunsdorf, west from Freiberg.

The following Calcareous Spars have a similar specific gravity and a similar hardness:

2·7259, greyish white, in large compact masses from Alten August in Freiberg.

2·7260, translucent, yellowish white, cleavage masses intermingled with Vitreous Copper, from Sangerhausen, Thuringia.

2·7272, smoke-grey, large crystals, from Neu Glück in Schneeberg in the Erzgebirge.

2·7284, white cleavage crystals, at Zaukerode near Dresden.
2·7300, a crystal from Northumberland.

The most of these varieties are too imperfectly cleavable to admit of accurate measurement.

vii. *Melinous Carbon-Spar.* BREITHAUPT.

P on P = 105° 17′.
Cleavage perfectly obtained parallel with the primary rhomboid.
Hardness (scale of BREITHAUPT) = 4 . . . 4·25.
Sp.gr. = 2·6958, honey yellow, cleavage crystals from Neudorf at Borna.
2·6968, from Mont Martre near Paris.

It is found in green-sand and in plänerkalkstein in Saxony. It also occurs at Cotta, at Naundorf in Borna, and again on the lower portions of Zehista in the region of Pirna. Under similar circumstances at Dux in Bohemia.

viii. *Diastatic Carbon-Spar.* BREITHAUPT.

P on P = 105° 43′.
Cleavage parallel with primary rhomboid perfect.
Hardness (scale of BREITHAUPT) = 4 . . . 4·25.
Sp.gr. = 2·7698, massive variety from Seegen Gottes, Freiberg.
2·7758, cleavage crystals from Habacht, Freiberg.
2·7870 common fibrous limestone, from Adam Heber in Schneeberg.

ix. *Plumbo-Calcite.* TURNER. Carbonate of Lime and Lead.

P on P = 104° 53′ 30″.
Hardness. It is scratched by Iceland Spar.
Surface of crystals slightly rounded.
Lustre pearly. Sp. gr. = 2·82.
Massive and opake.

Heated in a platina crucible, or in a glass tube, it decrepitates, and after some time assumes a brownish, or pale reddish tint. It consists of

Carbonate of lime	92·2
Lead	7·8

x. *Prunnerite.* ESMARK.

The violet blue variety of Calcareous Spar, occurring with Apophyllite in the Island of Hestoe, one of the Faroes, and hitherto arranged as a variety of cuboidal Calcareous Spar, has been established into a distinct

species by ESMARK; the grounds of this distinction however, are not as yet made known.

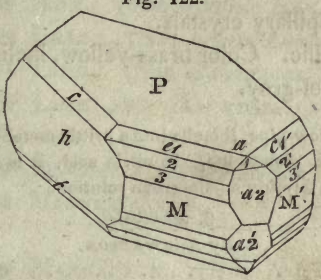
CALCEDONY. (See *Quartz.*)

CALEDONITE. Cupreous Lead-Baryte.

Primary form. Right rhombic prism. M on M′=95°.

Secondary form.

Fig. 122.



M on M′	95°	00′	BROOKE.	M on *e*1	144° 00′
P on M or M′	90	00		M on *h*	132 30
P on *a*2	108	00		*a*2 on *a*2′	143 42
P on *c*	126	00		*a*2 on *e*2	140 40
P on *e*1 or *e*1′	126	00		*c* on *h*	144 30
P on *e*2 or *e*2′	115	30		*e*1 on *e*1′	108 00
P on *h*	90	00		*e*2 on *e*2′	128 35

Cleavage, parallel to M and T indistinct, but parallel to *h* more obvious. Fracture uneven. Surface streaked.

Lustre resinous.

Color deep verdigris-green; inclining to mountain-green, if the crystals are very delicate. Streak greenish-white. Translucent.

Rather brittle. Hardness = 2·5 ... 3·0. Sp. gr. = 6·4.

1. *Analysis.*

By BROOKE.

Sulphate of lead . . .	55·8
Carbonate of lead . . .	32·8
Carbonate of copper . . .	11·4

2. It is found along with other ores of lead at the Lead Hills of Scotland.

CANNEL COAL. (See *Bituminous Coal.*)

CAOUTCHOUC MINERAL. (See *Bitumen.*)

CAPILLARY PYRITES. Capillary Chlorone-Pyrites.

Delicate, capillary crystals.

Lustre metallic. Color brass-yellow, inclining to bronze-yellow and steel-grey.

1. Before the blow-pipe, it melts into a brittle metallic globule; it colors glass of borax, violet-blue. In nitric acid, it is dissolved without leaving a residue, forming a pale green solution.

2. *Analysis.*
By ARFWEDSON.

Nickel	64·35
Sulphur	34·26

3. It occurs at Johanngeorgenstadt in Saxony, Joachimsthal in Bohemia, St. Austle in Cornwall, and in the Westerwald, accompanied by several species of Pyrites, and by Calcareous Spar.

CARBOCERINE.

The composition of this mineral, as carbonate of cerium, given by BERZELIUS, is all the information we possess concerning it.

CARBONATE OF BARYTES. (See *Witherite.*)

CARBONATE OF BISMUTH.

Earthy.

Color grey and brown.

Sp. gr. = 4·3.

1. *Analysis.*
By MCGREGOR.

Carbonic acid	51·50
Oxide of bismuth	28·80
Oxide of iron	2·10
Alumina	7·50
Silica	6·70
Water	3·60

2. It was found at St. Agnes in Cornwall.

3. From the inconsistency of the chemical results obtained above, with the known laws of chemical combination, it seems probable that some mistake has been committed in the analysis.

CARBONATE OF COPPER. (See *Blue Malachite* and *Green Malachite.*)

CARBONATE OF IRON. (See *Spathic Iron.*)

CARBONATE OF LEAD. (See *White Lead-ore.*)

CARBONATE OF LIME. (See *Calcareous Spar.*)

CARBONATE OF LIME AND MAGNESIA. (See *Dolomite.*)

CARBONATE OF MAGNESIA. (See *Magnesite.*)

CARBONATE OF MAGNESIA AND IRON. (See *Rhomb Spar.*)

CARBONATE OF MANGANESE. (See *Diallogite.*)

CARBONATE OF SODA. (See *Natron* and *Trona.*)

CARBONATE OF SODA AND LIME. (See *Gay-Lussite.*)

CARBONATE OF STRONTIAN. (See *Strontianite.*)

CARBONATE OF ZINC. (See *Calamine.*)

CARBONIC-ACID. Aeriform Carbonic-Acid. MOHS.

Gaseous. Transparent.

Sp. gr. =1·51961. BIOT and ARAGO. Taste slightly acidulous; pungent.

1. It extinguishes burning bodies of all kinds, and is incapable of supporting the respiration of animals. It reddens the vegetable blues; but the original color is restored by heating, or exposure to the air. Lime and barytic-water, become turbid when brought into contact with it; and it is absorbed by recently boiled water at the common pressure and temperature, in a quantity equal to the volume of the water. Under a pressure of 36 atmospheres, carbonic acid becomes converted into a liquid.

Carbonic-Acid.

2. *Analysis.*

By BERZELIUS.

Carbon	27·40
Oxygen	72·60

3. It is found in the largest quantity and highest degree of purity upon the surface of *carbonated* springs, and in caves; in which cases it issues directly from the earth. Of the most remarkable of these sources of the present species in the United States, are the springs of Saratoga and Ballstown near Albany. An ingenious hypothesis to account for the origin of the carbonic acid in these localities, and many others of less importance in the vicinity, has been proposed by Prof. EATON. The rock through which the waters rise is an argillite, containing large quantities of iron-pyrites and carbonate of lime. The iron-pyrites, he conceives, is decomposed by water, the sulphuric acid thus formed being in contact with the carbonate of lime, gypsum is produced, and carbonic acid disengaged; which being situated at great depths in the earth, and consequently under great pressure, combines with water in large proportions; and when the waters thus charged issue from the earth, the pressure being removed, they part with their superabundant carbonic acid. The well known mineral springs of Tunbridge and Carlsbad are remarkable for the evolution of this acid gas. It issues from a small cave in the side of a mountain near Naples, the floor of which, to the depth of a foot or more, is covered with a stratum of this noxious fluid, into which, if a dog be introduced, he is immediately suffocated. It has hence been called the *grotto del cane.* Another cave of a similar character exists in the Büdös hegy, a porphyry mountain in Transylvania. Carbonic acid is also emitted from certain marshes, and from the solfataras. In addition to the foregoing sources of this species, it is formed abundantly by the combustion of all substances that contain carbon, the respiration of animals, and the spontaneous changes to which dead animal and vegetable matter is subject. Accordingly, it is always present in the atmosphere, even at the highest elevations. All kinds of spring and well-water contain it dissolved in them, and to the presence of which they are partly indebted for their agreeable flavor. Where carbonic acid is evolved in low situations, it is liable from its gravity to accumulate; a circumstance which often happens in deep mines and wells, in which it forms an atmosphere known in English by the name of *choke-damp*, in German by the name of *Schwaden* or *Swath.*

4. Carbonic acid is applied to a variety of purposes in medicine and the arts.

CARBURETTED HYDROGEN. Empyreumatic Hydrogen Gas. Mohs.

Amorphous. Transparent. Expansible.

Sp. gr.=0·5707. Odor empyreumatic.

1. It burns with a bright flame, sometimes tinged with blue.

2. *Analysis.*

Carbon	74·87
Hydrogen	25·13

3. It is developed from marshes and stagnant pools, and is also found in volcanic countries. But its greatest source is certain coal mines and salt springs.

4. It is particularly abundant at Newcastle and Liège, where it is denominated fire-damp. Numerous localities of it might be cited in Ohio and New York; the more remarkable of which, however, is Fredonia, 40 miles from Buffalo, where it was first observed to bubble up from a small stream; but on boring a hole 1½ inch in diameter through a soft fetid limestone rock, of no great thickness, the gas left the stream, and was discharged by this orifice. The brilliancy of the flame led to its being adopted as a means of illuminating the village. A gazometer collects 80 cubic feet in 14 hours.

Carburet of Iron. (See *Plumbago.*)

Carnelian. (See *Quartz.*)

Cavolinite. (See *Nephiline.*)

Ceylanite. (See *Spinel.*)

CELESTINE. Prismatoidal Hal-Baryte. Mohs.

Primary form. Right rhombic prism. M on M′ = 104°.

Celestine.

Secondary forms.

Fig. 123.

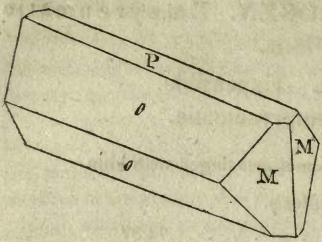


Fig. 124.

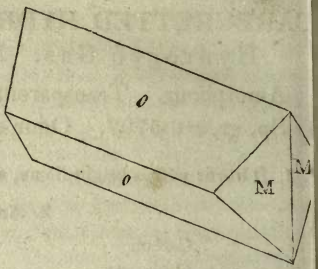


Fig. 125.

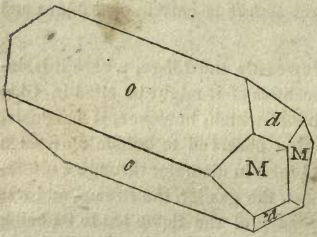


Fig. 126.

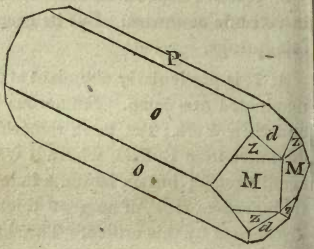


Fig. 123, the primary with its acute solid angles replaced by single planes. P on o=128° 31′. Fig. 124, the same, in which the terminal plane of the primary is extinguished. o on o=102° 58′; o on o over the summit=77° 2′. Fig. 125, like Fig. 124, but having the obtuse solid angles replaced by planes d; d on d = 78° 28′. Fig. 126, P on d=140° 46′; M on z=154° 6′.

Cleavage parallel to the sides of the primary form, highly perfect; that of the bases less distinct. Fracture imperfectly conchoidal, uneven.

Celestine.

Lustre vitreous, inclining to resinous; sometimes also, a little to pearly on the perfect faces of cleavage. Color white prevalent, passing into bluish-grey, sky-blue and smalt-blue. Also reddish-white and flesh-red. Transparent ... translucent.

Brittle. Hardness = 3·0 ... 3·5. Sp. gr. = 3·858, a white translucent, cleavable variety, from the Tyrol.

Compound Varieties. Imperfect globular shapes, surface drusy, composition columnar. Plates more or less thin: surface rough, composition columnar, thin and parallel. Massive: composition either lamellar and aggregated into larger granular masses; or columnar, generally straight and divergent; or granular, the individuals being of various sizes. Faces of composition smooth, rough or irregularly streaked.

1. The varieties of the present species have been variously divided in the mineralogical systems into subspecies and kinds, notwithstanding they are connected among themselves by immediate transitions. Tabular crystals, and lamellar compound masses, were called *foliated Celestine;* others of columnar crystallizations and compositions, *prismatic Celestine.* Among the massive varieties were distinguished *radiated Celestine*, consisting of thin columnar compositions, radiating from a centre; *fibrous Celestine*, comprehending the thin plates, formed by delicate columnar particles of composition; and compact Celestine, which is a mechanical mixture of Celestine and Calcareous Spar.

Before the blow-pipe, Celestine decrepitates and melts, without perceptibly coloring the flame, into a white friable enamel. It loses its transparency on being heated, and acquires a caustic taste different from that of Heavy Spar under similar circumstances. Reduced to powder, it phosphoresces upon red hot iron.

2. *Analysis.*

By KLAPROTH.

Strontia	56·00
Sulphuric acid	44 00

3. Celestine is rarely found in greywacke: its usual localities are in transition limestone, sandstone and trap rocks; in which it occurs in single kidney-shaped masses, in large massive concretions, and in vesicular cavities. Other deposits are in gypsum beds, alternating with marl and clay, and associated with sulphur.

4. The handsomest prismatic-shaped crystals, and massive columnar varieties, occur in the Sulphur mines of Sicily; also under the same circumstances at Bex in Switzerland, and Conil near Cadiz in Spain. Tabular crystals and lamellar compositions are found in beautiful varieties at Monte Viale, near Verona, and in the Bristol Channel in England. Fine varieties occur in the Seiseralpe in the Tyrol. The blue varieties occur in greywacke at Leogang in Salzburg, and at Meudon, near Paris. The blue columnar varieties occur at Dornburg near Jena. The compact is found in the tertiary of Montmartre near Paris. Magnificent crystallizations of Celestine of a delicate blue color have been found in the secondary limestone bordering on lake Erie: particularly at a place called Strontian Island in that lake. Columnar, as well as lamellar, varieties, are found under similar circumstances at Lockport and Scoharie, (N.Y.)

CEREOLITE. (See *Kerolite*.)

CERINE. (See *Allanite*.)

CERITE. Uncleavable Eruthrone-Ore.

Regular forms and cleavage unknown.

Lustre adamantine. Color intermediate between clove-brown and cherry-red, passing into grey. Streak white. Translucent on the edges.

Brittle. Hardness = 5·5. Sp. gr. = 4·912.

Compound Varieties. Massive: composition granular, individuals not distinguishable; fracture uneven and splintery.

1. Alone before the blow-pipe, it is infusible; but with borax forms an orange-yellow globule, which becomes paler on cooling. With soda it does not perfectly dissolve; but forms a semi-fused, dark yellow mass.

2. *Analysis.*

By HISINGER.

Oxide of cerium - - -	68·59
Silica - - -	18·00
Oxide of iron - - -	2·00
Lime - - -	1·25
Water and carbonic acid - -	9·60

3. This rare mineral occurs in a bed of gneiss at the copper mine of Nya Bastnaes, near Riddarhyttan, Westmoreland, in Sweden. It is accompanied by Bismuthine and Mica.

CHABASIE. Rhombohedral Kouphone-Spar. MOHS.

Primary form. Rhomboid. P on P = 94° 46′.

Secondary forms.

Fig. 127.

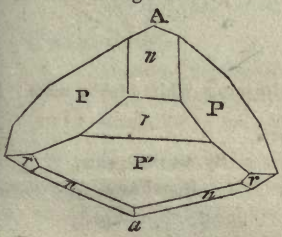


Fig. 128.

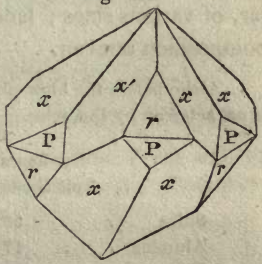


Fig. 127, the primary, having the upper edges and the lateral angles replaced by tangent planes. P on $r = 120°$ 5′. n on $r = 143°$ 59′. Fig. 128, the same, in which the edges between P and r are replaced by the planes x. x on $x' = 173°$ 32′. x on x' (over the base) $= 96°$ 40′. P on $x = 175°$ 30′.

Cleavage parallel to the primary rhomboid, but not distinct. Fracture uneven. The faces P are generally striated parallel with the upper edges of the rhomboid.

Chabasie.

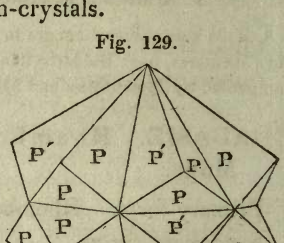
Lustre vitreous. Color white or reddish white: rarely yellowish white. Streak white. Semi-transparent . . . translucent.

Brittle. Hardness $=4{\cdot}0 \ldots 4{\cdot}5$. Sp. gr. $=2{\cdot}100$, crystals from Bohemia.

Compound Varieties. Twin-crystals.

In this figure the face of composition coincides with the vertical axis; and the angle of revolution $= 80°$. Fig. 127, in place of the primary, sometimes enters into composition in the same way. Massive: composition granular, of various sizes; faces of composition uneven.

Fig. 129.



1. Alone before the blow-pipe, it melts into a white blebby mass. It is not acted on by the acids.

2. *Analysis.*

	By Berzelius, from Gustavusberg.	By Arfwedson, from Fassa.	
Silica	50 65	48·38	49·07
Alumina	17 90	19·28	18·90
Water	19·90	21·40	19·73
Lime	9·37	8·70	
Potash	1·70	2·50	12·19 with soda.

3. Chabasie chiefly occurs in the cavities of amygdaloidal rocks. It has been found also in seams between the layers of gneiss and mica-slate. It is accompanied by Stilbite, Laumonite, Calcareous Spar and Quartz.

4. The largest and most distinct crystals are found in Iceland, the Faroe islands, and the vicinity of Aussig in Bohemia. Other localities are Altenberg near Oberstein in Saxony, Talisker in the isle of Skye, Glen Fary in Perthshire in the north of Ireland, and near Swan's creek in the Basin of Mines, Nova Scotia. At this last named place it occurs of a

Chabasie.

wine yellow or flesh-red color, in crystals of various sizes, and often highly modified: they exist in the cavities of amygdaloidal rocks, accompanied by Analcime, Calcareous Spar and Heulandite. In the United States, Chabasie is occasionally met with in the trap region of the Connecticut river; also in seams between the layers of a mica slate rock at Chester, (Mass.) and at Baltimore, (Maryland,) under similar circumstances. It occurs on gneiss with Stilbite, at Hadlyme, (Ct.)

Chalkolite. (See *Uranite.*)

Chalkopyrite. (See *Yellow Copper-Ore.*)

Chalkosiderite.

In very thin tabular crystals: stalactitic and drusy. Fracture fibrous and foliated. Color green, mostly yellowish. Lustre pearly. "Half-hard." Sp. gr. = 3·392.

Chalkosine. (See *Vitreous Copper.*)

Chalkotrichite.

The capillary variety of *Red Copper-ore.* q. v.

Chamoisite.

Massive; composition impalpable, or oolitic.

Color greenish-grey.

Scratched by the point of a knife. Sp. gr. = 3·0 ... 3·4.

1. It yields moisture when heated in a glass tube, at the same time assuming a blacker color, and becoming more magnetic. It dissolves in the strong acids, leaving behind a portion of gelatinised silica.

2. *Analysis.*

By Berthier.

Silica - - - -	14·3
Alumina - - - -	7·8
Protoxide of iron - - - -	60·5
Water - - - -	17·4

In addition to the above, it contains variable proportions of carbonate of lime and magnesia.

3. It occurs in beds of moderate thickness in the limestone mountain of Chamoison in the Vallais, France.

4. It is explored with profit as an ore of iron.

5. The Chamoisite appears to be an impure variety of Magnetic Iron-Ore.

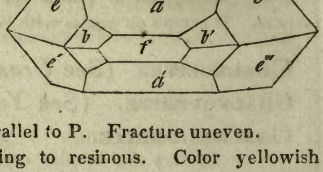
CHILDRENITE.

Primary form. Right rhombic prism. M on M′ = 92° 48′.

Secondary form.

P on *e* or *e*″	- -	114°	50′
P on *a*	- -	152	10
P on *f*	- -	90	00
e on *e*′	- -	130	20

Fig. 130.



Cleavage, imperfect, parallel to P. Fracture uneven.

Lustre vitreous, inclining to resinous. Color yellowish white, wine-yellow, ochre-yellow, and pale yellowish-brown. Streak white. Translucent.

Hardness = 4·5 . . . 5·0.

1. Dr. WOLLASTON found this mineral to be a compound of phosphoric acid, alumina, and iron.

2. It has hitherto been found only in the neighborhood of Tavistock, disposed in rough crystals and crystalline coats on Spathic Iron, Iron Pyrites and Quartz, occasionally accompanied by Fluor.

3. Childrenite approaches in several of its properties the species Lazulite, the planes *a a* of whose crystals may be considered as corresponding to M M of Childrenite.

CHLORITE. (See *Talc.*)

CHLOROMELAN. (See *Cronstedite.*)

CHLOROPAL. (See *Opal.*)

CHLOROPHÆITE.

Massive: in small grains, imbedded in basalt or trap, and sometimes hollow. Fracture conchoidal . . . nearly earthy.

Color pistachio green, and translucent or opake; but soon turning into brown and black on being exposed to the air, without losing its lustre: the same effect takes place in a longer time, to the depth of an inch or two, into the rock.

Brittle. Hardness, scratched by a quill. Sp. gr. = 2·020.

1. Before the blow-pipe, it remains nearly unchanged, altering neither its color nor transparency. Besides silica, it contains iron and a little alumina. It occurs in Scuirmore cliff in the island of Rum, also in Fife-

shire and in Iceland. It has been found at several places in the United States, among which may be mentioned those of Gill, (Mass.) and Southbury, (Conn.)

2. It appears to be decomposed Mesotype.

CHONDRODITE. (See *Brucite.*)

CHRISTIANITE. (See *Anorthite.*)

CHROMATE OF LEAD. (See *Red Lead-Ore.*)

CHROME-OCHRE. Chromic Lusine-Ore.

Massive: composition impalpable: earthy and pulverulent.

Color dark green.

1. Infusible before the blow-pipe, but changes to a lighter green. With borax, it gives a fine green color.

2. *Analysis.*

Oxygen	- - - - -	29·89
Chrome	- - - - -	70·11

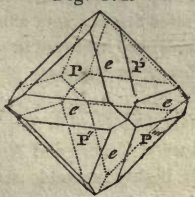
3. It sometimes occurs pure, but more frequently mingled with earthy matters, as in the mountains of Ecouchets, between Conches and Creuzot, Saone and Loire. Also with Feldspar at Elfdalen in Dalecarlia, and in serpentine rocks in the Alps of Savoy and Piedmont.

CHROME-ORE. Chromated Iron-Ore.

Primary form. Regular octahedron.

Secondary form.

Fig. 131.



Hoboken, (New Jersey,) and Bare Hills, (Maryland.)

Cleavage parallel with the primary form rather imperfect. Fracture uneven, or imperfectly conchoidal.

Chrome-Ore.

Lustre imperfectly metallic. Color between iron-black and brownish-black. Streak brown. Opake.

Brittle. Hardness = 5·5. Sp. gr. =4·498, a variety from Stiria.

Compound Varieties. Massive: composition granular, the individuals being of various sizes, and generally firmly connected.

1. Alone before the blow-pipe, it is infusible, but acts upon the magnetic needle after having been exposed to the reducing flame. It is with difficulty wholly soluble in borax, to which flux it imparts a beautiful green color.

2. *Analysis.*

	By Vauquelin.	By Klaproth.
Oxide of chrome	43·00	55·50
Protoxide of iron	34·70	33·00
Alumina	20·30	6·00
Silica	2·00	2·00

3. The varieties of Chrome-Ore have been hitherto found only in serpentine, in irregular veins and beds, which appear to be of contemporaneous formation with the rock itself.

4. This species was first found in the department of du Var in France, where it formed nodules and kidney shaped masses. In Stiria it occurs in the Gulsen mountain near Kraubat, in serpentine, in very irregular veins. Other localities are, Portsoy in Banffshire, and at Buchannan in Stirlingshire, in Scotland; in the latter place imbedded in limestone: at Unst and Fetlar in the Shetland isles, in Silesia, Bohemia and the Uralian mountains. In the United States a very abundant deposit exists at the Bare Hills near Baltimore, where it occurs in veins or masses in serpentine. The crystals are found at the same place in channels worn by water about the base of the hill. At Hoboken in New Jersey, it is found both massive and in crystals, imbedded in Serpentine and Dolomite; and under similar circumstances at Milford and West Haven, (Conn.)

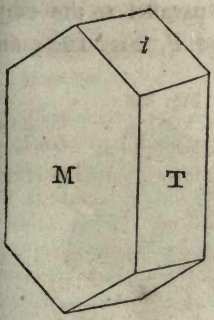
5. The Chrome-Ore is highly valuable for extracting the oxide of chrome, which is employed either alone, or in various combinations with the oxides of other metals, as cobalt, lead, mercury, &c., both for painting on porcelain, and for painting in oil. It yields green, yellow and red pigments.

CHRYSOBERYL. Prismatic Emerald.

Primary form. Right rectangular prism.

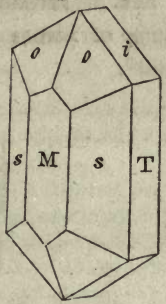
Secondary forms.

Fig. 132.



Haddam, (Conn.)

Fig. 133.



Siberia.

Fig. 134.

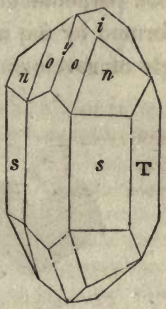


Fig. 132, the primary having the terminal plane obliterated by the extension of the planes *i*, which replace the shorter terminal edges. *i* on *i* = 120°, *anamorphique* of Hauy.—Fig. 133, in addition to the new planes *i*, the terminal angles and the lateral edges are replaced. *o* on *i* = 133° 19′, H. *o* on M = 136° 41′, H. M on *s* = 125° 16′.—Fig. 134 is the *octovigésimale* of Hauy. *n* on *o* = 163° 53′ H. T on *n* = 126° 8′ H.

Cleavage distinct parallel to the primary form; effected with ease parallel to M, but with difficulty in the direction of T and P. Traces of a diagonal cleavage. Fracture conchoidal. Surface, the vertical planes striated longitudinally; the remaining ones generally smooth and even.

Lustre vitreous. Color asparagus-green, passing into greenish-white, olive green, and yellowish-grey. Streak white. Transparent... translucent: sometimes exhibiting

a bluish opalescence when viewed perpendicular to the narrow lateral plane of the primary.

Hardness=8·5. Sp. gr. =3·754, a transparent variety.

Compound Varieties. Twin-crystals: face of composition perpendicular, axis of revolution parallel to the edge formed by the meeting of planes *i* and T, Fig. 132; angle of revolution=60°.

Fig. 135.

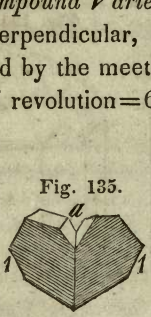
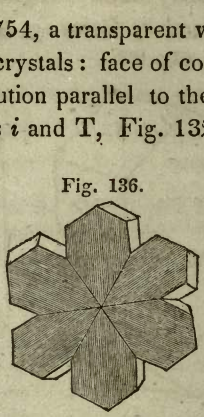


Fig. 136.



In Fig. 135, the crystals project beyond the face of composition only at one extremity; it is rare to find them projecting at both extremities, although these do sometimes occur at Greenfield, (N.Y.) Occasionally the sides 1 are so deeply replaced as to convert the macle into a triangular prism; and when this is the case, the re-entering angle at *a* is not visible, the composition being detected only by the striæ. In Fig. 136, three prisms cross each other, or the composition is repeated; and the prisms project at each end beyond the faces of composition. Rarely crystals are found, in which they project only at one end, in which case the form which results is represented by the upper half of Fig. 136; and still more rarely they are found in which they project at neither extremity, when a regular hexagonal table is produced.

1. It remains unchanged, if exposed alone or with soda to the heat of the blow-pipe, only the surface in the latter case becomes dull. It is with difficulty fusible with borax and salt of phosphorus.

2. *Analysis.*

	By Seybert, fr. Haddam.	By Seybert, fr. Brazil.	By Thomson and Muir, fr. Brazil.
Alumina	73·60	68·666	76·752
Glucina	15·80	16·000	17·791
Silica	4·00	3·999	0·000
Protoxide of iron	3·38	4·733	4·494
Oxide of titanium	1·00	2·666	0·000
Moisture	0·40	0·666	0·480

3. Chrysoberyl is found in granite veins associated with Tourmaline, Beryl and Garnet: also in the alluvial deposits of rivers, along with other species of gems.

4. It occurs in Brazil along with Diamond and Topaz, also in Ceylon; in which places it has been found only in sand. The most interesting deposits of this species are in the United States, at Haddam, (Conn.) and Greenfield, near Saratoga, (N.Y.) At the former place it is associated with Garnet, Beryl, Automalite and Columbite; and at the latter with Tourmaline, Garnet and Apatite. In both cases it exists in granite, traversing gneiss in veins.

CHRYSOCOLLA. Staphyline Malachite-Haloide.

Regular forms unknown. Cleavage none. Fracture conchoidal.

Color emerald-green, pistachio-green, asparagus-green, passing into sky-blue. If they incline to brown, the mineral is impure. Streak white, a little shining. Semi-transparent . . . translucent on the edges.

Rather sectile. Hardness = 2·0 . . . 3·0. Sp. gr. = 2·031, a semi-transparent variety.

Compound Varieties. Botryoidal, reniform shapes or massive varieties: composition impalpable; fracture more or less perfectly conchoidal. Pseudomorphoses in the shape of Red Copper-Ore and of Copper-Mica. Impure varieties are often earthy.

Chrysocolla.

1. Before the blow-pipe, upon charcoal, it first becomes black; and in the inner flame, red, without melting. With borax, it melts into a green glassy globule, and is partly reduced, as the metallic particles which this globule contains, evince. If pure it is soluble in nitric acid, without effervescence, and leaves a residue of silica.

2. *Analysis.*

	By KLAPROTH.	By JOHN.	By BOWEN, from N. Jersey.
Copper	40·00	42·00	45·175
Oxygen	10·00	7·63	
Silica	26·00	28·37	37·250
Water	17·00	17·50	17·000
Carbonic acid	7·00	3·00	0·000
Sulphate of lime	0·00	1·50	0·000

3. The natural repositories of Chrysocolla are those of other ores of copper, where it is found along with them, and also with Brown Iron-Ore and Quartz.

4. It occurs at Saalfield in Thuringia, at Lauterberg in the Hartz, at Saska and Moldawa in the Bannat, at Herrengrund in Lower Hungary, at Falkenstein and Schwatz in the Tyrol, in the Lizard district in Cornwall; in Norway, Siberia, Mexico and Chili. In the United States, at a copper mine in Sommerville, (New Jersey,) Chrysocolla is found accompanying Red Copper-Ore, Native Copper, and Green Malachite. In Nova Scotia, at the Basin of Mines, associated with other ores of copper, and with Brown Iron-Ore.

CHRYSOLITE. (See *Olivine.*)

CHRYSOPRASE. (See *Quartz.*)

CHUSITE. (See *Olivine.*)

CIMOLITE.

A pearl, or reddish grey clay, tender to the feel, and falling to pieces in water. It consists, according to KLAPROTH, of

Silica	63·00
Alumina	23·00
Water	12·00
Oxide of iron	1·25

It is not known from the decomposition of what mineral it is derived. It occurs at Argentiera, (Cimolis,) an island in the Grecian Archipelago.

CINNABAR. Peritomous Melacone-Blende.

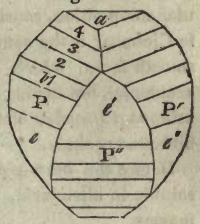
Primary form. Rhomboid. P on P′ = 72°.

Secondary form.

P on P′	71°	48′
P on *b*2	157	20
P on *b*3	152	8
P on *e*	159	18
a on *b*1	127	5
a on *b*2	133	25
a on *b*3	138	34
a on *b*4	146	31
e″ on *b*1	142	55
e on *b*3	142	26

HAÜY.

Fig. 137.



Cleavage parallel to the primary form, highly perfect. Fracture conchoidal. Surface of the crystals horizontally streaked, sometimes very deeply.

Lustre adamantine, inclining to metallic in dark colored varieties. Color several shades of cochineal-red, the darker varieties inclining to lead-grey. Streak scarlet-red. Semi-transparent . . . translucent on the edges.

Sectile. Hardness = 2·0 . . . 2·5. Sp. gr. = 8·098, the cleavage variety from Neurmarktel.

Compound Varieties. Twin-crystals. like Fig. 84, of the compound varieties of *Calcareous Spar.* Rarely in some indistinct imitative shapes. Massive : composition granular, of various sizes of individuals, generally small and often impalpable. In the last case, fracture becomes uneven, even, or flat conchoidal. Plates, superficial coatings. There is sometimes a tendency to thin columnar composition, the mass being friable, and the color scarlet red.

Cinnabar.

1. The *Hepatic Cinnabar* is a compound variety of Cinnabar, which is impure, and having on that account a streak inclining to brown. The *dark red* Cinnabar includes the crystals, and those compound varieties in which the individuals are still discernible; it is generally cochineal-red. The *bright red* Cinnabar is friable, and of a scarlet-red color. The *compact* Hepatic Cinnabar contains reniform massive varieties of a granular composition, consisting of impalpable individuals. The *slaty* Hepatic Cinnabar is the same thing, only interrupted by irregularly streaked smooth faces, which possess a slaty appearance. These however are accidental, not having any relation to the composition itself. The *Bituminous Cinnabar* consists of Cinnabar, intermixed with coarse coal or bituminous shale.

Before the blow-pipe, the pure varieties are easily volatilized. It is soluble in nitric acid. On being sublimated, it crystallizes in columnar masses.

2. *Analysis.*

By KLAPROTH.

Mercury	.	.	84·50	.	. 85·00
Sulphur	.	.	14·75	.	. 14·25

3. Cinnabar chiefly occurs in beds, accompanied by Native Mercury, Native Amalgam, and sometimes only by Calcareous Spar and Quartz. Some of its varieties have been found in veins, where they occur along with several ores of iron.

4. It occurs in beds in gneiss, at Richenaw in Upper Carinthia, and at Hartenstein in Saxony; also at Dumbrawa in Transylvania, in grey-wacke. It is found included in irregular veins, situated in beds of limestone, at Harmagor, Windisch-Kappel, and other places in Carinthia, but particularly at Neumarktel in Carniola, the Palatinate, and Almaden in Spain. At Idria, it occurs in beds of bituminous shale, with Bitumen and dark grey sandstone, associated with limestone. Other localities are Schemnitz, Cremnitz, and Rosenau in Hungary, at Horzowitz in Bohemia, in the Erzberg, near Eisenerz in Stiria. The Hepatic Cinnabar has been found only at Idria; the bright-red Cinnabar at Wolfstein in the Palatinate. Cinnabar likewise abounds in Mexico and Peru, in China and Japan.

5. It is used for the extraction of mercury; if very pure, it is employed as a pigment in its natural state.

CLAUSTHALITE. Paratomous Polypoione-Glance.

Massive: individuals granular: the larger ones having one bright cleavage; also in minute lamellar masses.

Lustre metallic. Color lead-grey, with a tinge of blue. Streak dark grey.

Hardness, below Galena. Sp. gr. = 6·8.

1. Heated in a glass tube before the blow-pipe, the selenium sublimes and fills the upper part of the tube with crystals of selenic acid. Upon charcoal it smokes, and tinges the flame of the blow-pipe blue. Cold nitric acid, after some time, causes the mass to assume a red color in consequence of the separation of selenium.

2. *Analysis.*

	By Rose.	By Stromeyer.
Lead	72·3	70·98
Selenium	27·7	28·11
Cobalt	00·0	0·83

3. It is found in the eastern part of the Hartz, at several places not far apart, one of which is Lorenz, near Klausthal; another is near Zorge, in the veins of iron-ore which traverse the argillite; and another still is near Tilkerode. The mineral is contained in a dolomite or argillite, accompanied by Malachite and Quartz.

Appendix to Seleniuret of Lead.

i. *Seleniuret of Lead with Seleniuret of Cobalt.*

Sp. gr. = 7·697. Found by Rose to contain

Lead	63·92
Cobalt	3·14
Selenium	31·42
Iron	0·45
Loss	1·07

It is found near Klausthal, engaged in dolomite.

ii. *Seleniuret of Lead with Seleniuret of Copper.*

Sp. gr. = 5·0 . . . 7·0. Analysis by Rose.

Selenium	29·96
Iron with traces of lead	0·44
Lead	59·67
Iron	0·33
Copper	7·86
Undecomposed and loss	1·74

Another sample gave,

Selenium	-	-	-	34·26
Copper	-	-	-	15·45
Lead	-	-	-	47·43
Silver	-	-	-	1·29
Oxide of lead and iron	-	-	-	2·08

From Tilkerode, in veins of dolomite with Malachite.

iii. *Seleniuret of Lead and Mercury.*

Sp. gr. = 7·3.

Selenium	-	-	-	24·97
Lead	-	-	-	55·84
Mercury	-	-	-	16·94
Loss	-	-	-	2·25

It gives when heated in an open tube a yellow sublimate of the seleniate of mercury.

It is found at the mine Tilkerode, engaged in dolomite.

CLEAVELANDITE. (See *Albite.*)

COBALT-BLOOM. Diatomous Cobalt-Mica.

Primary form. Right oblique-angled prism. M on T = 124° 51′.

Secondary form.

Fig. 138.

The greater terminal edges are replaced by single planes, and the lateral edges by two planes. k on k = 130° 10′. s on s = 94° 12′. l on l = 118° 23′.

Cobalt-Bloom.

Cleavage, parallel to P perfect: that parallel with M and T scarcely visible. Surface, P and T streaked vertically.

Lustre upon P pearly, particularly if produced by cleavage. The rest of the faces possess adamantine lustre inclining to vitreous.

Color, crimson-red, cochineal-red, peach blossom-red, sometimes pearl-grey or greenish grey. The red tints of the former, by transmitted light, incline much more to blue if seen in a direction perpendicular to P. Streak corresponding to the color, though a little paler. If the mineral be crushed into powder in a dry state, this powder possesses a deep lavender-blue tinge, which is not the case if the powder be comminuted in water. Transparent to translucent on the edges. Crystals are least transparent in a direction perpendicular to P.

Sectile; thin laminæ are flexible in one direction. Hardness = 1·5 . . . 2·0; the lowest degrees are upon P. Sp. gr. = 2·948, a red crystallized variety from Schneeberg.

Compound Varieties. Implanted globular and reniform shapes; surface drusy; composition more or less perfectly columnar of various sizes of individuals, faces of composition either smooth or rough. Massive, composition columnar, often stellularly divergent, and aggregated in a second granular composition, faces of composition rough. Sometimes in a state of powder, as a coating upon other minerals.

1. Alone, before the blow-pipe, it assumes a darker hue. Upon charcoal, it emits copious arsenical fumes, and melts in the inner flame, into a bead of arseniuret of cobalt. With borax and other fluxes, it yields a fine blue colored salt.

2. *Analysis.*

By Bucholz.

Oxide of cobalt - - - -	39·00
Arsenic acid - - - - -	37·00
Water - - - -	22·00

3. Cobalt-bloom occurs in veins, traversing rocks of various ages, and also in beds. It is accompanied by Copper Nickel, Smaltine, Native Bismuth, Malachite, Quartz and Calcareous Spar.

4. The principal localities of this species are Schneeberg and Annaberg in Saxony, and Platten in Bohemia, where it occurs in veins in primitive rocks; Saalfeld in Thuringia, Riegelsdorf and Bieber in Hessia, where it is found in veins in secondary mountains. Other locatities are Würtemberg in Prussia, Tyrol, Norway, Sweden, Cornwall and Scotland.

5. When in sufficient quantity, it is employed in the manufacture of smalt.

COBALTINE. Hexahedral Eruthleucone-Pyrites.

Primary form. Cube.

Secondary forms.

1. Cube with its angles replaced by tangent planes.

2. Regular octahedron.

3. Regular octahedron with its solid angles replaced by tangent planes.

Fig. 139.

Fig. 140.

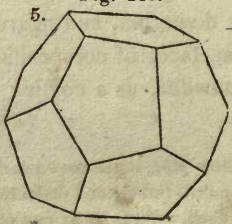
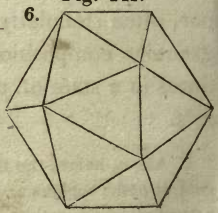


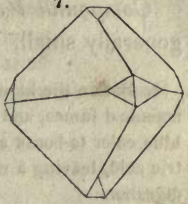
Fig. 141.



Cobaltine.

Fig. 142.

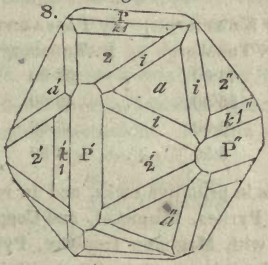
7.



Differing from fig. 139 by the reduction of the irregularly six-sided planes k, to small triangles.

Fig. 143.

8.



P on P′ or P′	90°	00′	00″	00‴	H.
a on a' or a''	109	28	16	00	P.
P or P″ on a	125	15	52	00	P.
P on $k1$, P′ on $k1'$, or P′ on $k2''$	166	30	00	00	P.
P on $k2$, P′ on $k2'$, or P′ on $k2''$	153	26	5	30	H.
a or a' on $k2$	140	46	17	00	P.
a on i	163	27	00	00	P.
$k2'$ on $k2'$	126	52	11	00	H.

The above crystals, all from Tunaberg, (Sweden.)

Cleavage parallel with faces of the cube, perfect. Fracture imperfectly conchoidal, uneven. Surface, the faces of the cube streaked in three directions perpendicular to each other. The remaining faces smooth.

Lustre metallic. Color silver-white, inclining to red. Streak greyish-black.

Cobaltine—Cobalt Vitriol.

Brittle. Hardness = 5·5. Sp. gr. = 6·298.

Compound Varieties. Massive: composition granular, generally small, but easily discernible.

1. Before the blow-pipe, upon charcoal, it gives a large quantity of arsenical fumes, and melts only, after having been roasted. It imparts a blue color to borax and other fluxes. It affords a pink solution with nitric acid, leaving a white residue, which is itself dissolved on further digestion.

2. *Analysis.*

	By Klaproth, fr. Tunaberg.	By Tassaert, fr. Tunaberg.	By Stromeyer, fr. Modum.
Cobalt	44·00	36·00	33·10
Arsenic	55·50	49·00	43·46
Iron	0·00	5·66	3·23
Sulphur	0·50	6·50	20·08

3. It occurs in beds in primitive rocks, and in veins. It is accompanied chiefly by Iron Pyrites, Mispickel, and Copper Pyrites; in beds, it is also associated with Magnetic Iron-Ore, Pyroxene, Hornblende, and Feldspar; in veins it is sometimes found with limestone and Heavy-Spar. The crystals found in beds are terminated on all sides.

4. This species occurs in the parish of Modum in Norway, at Tunaberg in Südermanland in Sweden, at Querbach in Silesia, and Bottallack near St. Just in Cornwall.

5. It is a valuable ore of cobalt, which metal is employed for painting in porcelain and the manufacture of smalt.

COBALT VITRIOL. Staphyline Vitriol-Salt.

Stalactitic and coralloidal shapes: composition columnar, in most cases impalpable. Friable.

Lustre vitreous: in very thin columnar compositions, it becomes pearly. Color flesh-red and rose-red . . . reddish white. Semi-transparent . . . translucent.

Taste astringent.

1. It communicates to borax a blue color; and is soluble in water.

2. *Analysis.*

By KOPP.

Oxide of cobalt	38·71
Sulphuric acid	19·74
Water	41·55

3. It occurs in the rubbish of old mines at Bieber in the neighborhood of Hanau.

COCCOLITE. (See *Pyroxene.*)

COLLYRITE.

Massive: composition impalpable. Color white. More or less translucent. Fracture conchoidal, with resino-vitreous lustre. Easily impressed by the nail, and shining when cut with the knife. Adheres strongly to the tongue.

1. Infusible before the blow-pipe, affording water by calcination, and at the same time becoming pulverulent. Forms a jelly in the acids.

2. *Analysis.*

	By KLAPROTH, from Chemnitz.	By BERTHIER, from Esquera.
Silica	14·0	15·0
Alumina	45·0	44·5
Water	42·0	40·5

3. It occurs in narrow seams in porphyry at Schemnitz, in the lead mines of Esquera in the Pyrenees, and at Weissenfels in Saxony.

COLOPHONITE. (See *Garnet.*)

COLUMBITE. Pyramidal Baryte-Ore.

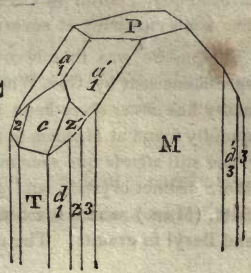
Primary form. Right rectangular prism.

Secondary form.

P on M or T	90°	00′
M on T	90	00
P on *a*1 or *a*1′	136	30
P on *c*	120	00
T on *d*1	156	30
T on *d*2	114	30
T on *c*	150	00

BROOKE.

Fig. 144.



Columbite.

Cleavage parallel with M and T rather distinct, especially that of M: the cleavage parallel with P less obvious. Fracture imperfectly conchoidal, uneven. Surface, M and T vertically streaked.

Lustre imperfectly metallic. Color greyish and brownish-black. Streak dark brownish-black, on the file a little shining. Opake.

Brittle. Hardness = 6·0. Sp. gr. = 6·038.

Compound Varieties. Massive: composition granular.

1. Upon charcoal, it suffers no change before the blow-pipe, but it melts with borax, and is partly soluble in heated sulphuric acid.

2. *Analysis.*

	By Berzelius.			By Vogel.	By Borkowsky,
	fr. Kimito.	fr. Finbo.	fr. Brodbo.	fr. Bodenmais.	
Columbic acid	83·2	66·99	68·22	75·00	75·00
Tungstic acid	0·0	0 00	6·19	0·00	0·00
Protoxide of iron	7·2	7·06	8·60	17·50	20·00
Protoxide of manganese	7·4	7·44	6·62	1·09	4·00
Oxide of tin	0·6	16·75	8·26	1·00	0·50
Lime	a trace.	2·40	1·19	0·00	0·00

The Columbite of Chesterfield, (Mass.) consists of the oxides of columbium, tin, iron and manganese, with a trace of lime.

3. Columbite occurs in granite veins, usually attended by Beryl.

4. It is found at Bodenmais in Bavaria, associated with Beryl and Uranite, where it exists in very distinct crystals. Also at Finbo and Brodbo near Fahlun in Sweden, with Topaz, Albite, and Quartz. It has been met with at several other places in Sweden and Finland.

Columbite was first discovered near New London, (Conn.) and the specimens sent by Gov. Winthrop to Sir Hans Sloane. The original locality has never since been re-discovered; but the mineral was subsequently found at Haddam in the well known Chrysoberyl deposit, which place still affords fine specimens of it, though in very limited quantity. More distinct crystals, and of greater magnitude, come from Chesterfield, (Mass.) where it exists along with variously colored Tourmalines and Beryl in granite. The most perfect crystals, as well as the largest

of this species which the United States have afforded, have been found at Acworth, (New Hampshire,) but the locality appears to be exhausted.

Appendix to Columbite.

Brown Tantalite of Kimito, Berzelius.

Sp. gr. = 7·9. Powder cinnamon-brown.

When heated with borax, in a very fine powder, it is with difficulty dissolved. The glass does not possess the color of the oxides of iron, except a dark green color, which exists only during the experiment. With salt of phosphorus, it is readily dissolved. It becomes minutely divided with soda, but does not dissolve, giving in the reduction flame a little tin, and upon platina-foil the reaction of manganese.

2. *Analysis.*

By Berzelius.

Columbic acid . . .	82·56
Protoxide of iron . . .	14·41
Protoxide of manganese . .	1·79
Oxide of tin . . .	0·56
Silica . . .	0·72

It is probable that future researches may render it necessary to divide the species Columbite, but at present our knowledge of the properties of its varieties do not justify the procedure.

COMMON SALT. Hexahedral Rock-Salt. Mohs.

Primary form. Cube.

Secondary forms.

Fig. 145.

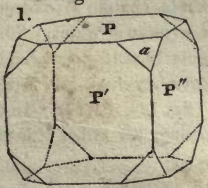
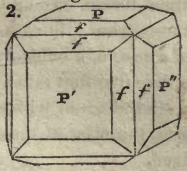


Fig. 146.



3. Octahedron.

Cleavage, parallel with the cube, perfect; rarely also the crystals cleave parallel with the diagonals of this form.

Common Salt.

Fracture conchoidal. Surface generally smooth.

Lustre vitreous, somewhat inclining to resinous. Color generally white, passing into yellow, flesh-red and ash-grey. Sometimes beautifully violet, berlin or azure-blue. Streak white. If scratched with the nail, it does not yield any powder, but receives an impression, and becomes a little shining. Transparent . . . translucent.

Rather brittle. Hardness = 2·0. Sp. gr. = 2·257, a yellowish-white transparent variety. Taste saline.

Compound Varieties. Dentiform and some other imitative shapes, rare. Commonly massive. Composition granular or columnar, the latter in most cases parallel, sometimes curved. Size of the component individuals various. Faces of composition rough.

1. Several varieties in the geological relations, and some differences in the chemical composition, have given rise to the subdivision of Common Salt into subspecies in the older books. Thus the varieties found in beds have been called *Rock-salt;* such as are found at the bottom of salt lakes, or on their shores, *Sea-salt;* and the former again have been divided into *foliated* and *fibrous* Rock-salt, according to their granular or columnar mode of composition.

Common salt is very easily soluble in water. It remains unaltered, if exposed to the dry atmosphere, and decrepitates upon glowing charcoal, or before the blow-pipe. It crystallizes, both from solutions in water, and from fusion. It undergoes a remarkable change if exposed to a moist atmosphere, in consequence of the absorption of water. The solution of a mass of a cubical shape begins regularly at its edges, and transforms the cube first into a cube with its edges bevelled, and finally into the icositetrahedron with triangular faces. (fig. 124. Part I.) In the latter form, the mass of the salt diminishes in size, till at last it is entirely dissolved.

2. *Analysis.*

By Henry. [*Rock-salt* variety.]

Muriate of soda . . .	983·25
Sulphate of lime . . .	6·50
Muriate of magnesia . . .	0·19
Muriate of lime . . .	0·06
Undissolved matter . .	10·00

3. Common salt occurs chiefly in beds, some of which are of considerable dimensions, though commonly of an irregular form, and is met with in secondary rocks, accompanied by gypsum, sandstone and clay. It is likewise found at the bottom and in the vicinity of salt lakes, in the waters of which it is dissolved. It is contained in the waters of salt springs, of several mineral wells, and of the sea, though in variable quantities. It occurs upon certain varieties of lava, and in some volcanic lakes.

4. In the solid state, it exists in large quantity in Poland, Hungary, Transylvania, Moldavia, and Walachia, in Stiria, Upper Austria, Salzburg, the Tyrol, Bavaria, Würtemberg and Switzerland; also in England and Spain, and numerous other countries in and out of Europe. In several of these countries, and also in several of the United States, Common Salt exists abundantly in salt springs, from which it may be obtained by means of evaporation. The variety sea-salt is found in the Crimea, in the deserts of the Caspian Sea, in Egypt, and in several places in Southern Africa and America.

5. The employment of common salt for culinary purposes, in different arts and manufactures, is too familiar to need enumeration.

COMPTONITE. Vesuvian Kouphone-Spar.

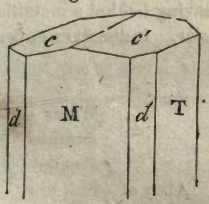
Primary form. Right rectangular prism.

Secondary form.

M on T	-	90°	00′
T on *c*′	-	93	00
c on *c*′	-	107	05
M on *d*′	-	135	35

} Phillips.

Fig. 147.



Cleavage parallel to T and M, the first a little more distinct; also parallel to the diagonal. Fracture small conchoidal, uneven. Surface *d* striated parallel to the edges of combination with M and T. The remaining faces smooth.

Comptonite.

Lustre vitreous. Color white. Streak white. Transparent . . . semi-transparent.

Hardness = 5·0 . . . 5·5.

1. Before the blow-pipe it gives off water, intumesces a little, and becomes opake; then it melts imperfectly into a vesicular glass. The globule obtained with borax is transparent, but vesicular; that obtained with salts of phosphorus contains a skeleton of silica, and becomes opake on cooling. With a little soda, it melts imperfectly; but with a larger quantity, it becomes infusible. The glass, with solution of cobalt, is dirty bluish-grey. It forms a gelatine when exposed in the state of powder to the action of nitric acid.

2. It occurs in the cavities of an amygdaloidal rock, along with Harmotome, at Mount Vesuvius.

Condurrite.

Massive: composition columnar, dividing into irregular portions like starch. Fracture flat conchoidal.

Lustre metallic. Color brownish-black. Sometimes highly polished, with a tinge of blue. In powder, soot black.

Hardness, does not scratch glass; is brittle, but yields to the knife, leaving a polished metallic-looking surface nearly of a lead-grey color.

1. A fragment placed on a red-hot coal, affords a copious white vapor, leaving behind a metallic substance, in a semi-fluid state of a yellowish color. It dissolves entirely in nitric acid.

2. *Analysis.*

By Faraday.

	Water . . .	8·98
	Arsenious acid . . .	25·944
Alloy of	Copper . . .	60·498
	Sulphur . . .	3·064
	Arsenic . . .	1·504
	Iron . . .	a trace.

It is probably a mechanical mixture of metallic arsenic, arseniate of copper, oxide of copper, and a little Copper Pyrites, one or more of these substances being in combination with water. Should this suggestion prove correct, it will not deserve to be ranked among the species of mineralogy.

3. It was discovered in the Condurrow mine at Cornwall.

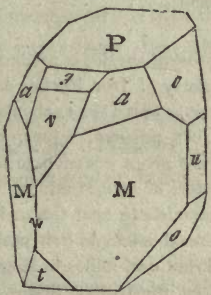
CONITE. (See *Dolomite.*)

COPPERAS. Hemi-Prismatic Vitriol-Salt. MOHS.

Primary form. Oblique rhombic prism. M on M′= 82° 20′. P on M or M′=99° 20′.

Secondary forms. The primary is almost invariably affected by slight replacements of the acute and obtuse solid angles, as well as of the acute and obtuse terminal edges. More rarely the lateral edges are removed also.

Fig. 148.



Cleavage, parallel to P perfect; that parallel to M less perfect. Fracture conchoidal. Surface generally smooth.

Lustre vitreous. Color, several shades of green, passing into white. Streak white. Semi-transparent...translucent. A faint bluish opalescence sometimes observable parallel to the faces M.

Rather brittle. Hardness =2·0. Sp. gr. =1·832 of a variety containing about 0·1 of sulphate of copper. Taste sweetish astringent and metallic.

Compound Varieties. Stalactitic, botryoidal, reniform: composition columnar; if the particles become very thin, the lustre approaches to pearly. Massive: composition granular. Pulverulent.

1. Before the blow-pipe it becomes magnetic, and colors glass of borax, green. It is easily soluble in water, and the solution becomes black on being mixed with tincture of galls. If exposed to the open air, it soon becomes covered with a yellow powder, which is persulphate of iron.

2. *Analysis.*

By BERZELIUS.

Oxide of iron	25·7
Sulphuric acid	28·9
Water	45·4

3. In most cases, the present species is produced by the decomposition of other minerals, particularly of Iron Pyrites and White Iron Pyrites; and it is therefore commonly found in such places, in which artificial heaps, constructed for that purpose, mines, or other circumstances brought about by art, have given occasion to its formation. It is also found dissolved in the waters of several mines.

4. It occurs in the Rammelsberg near Goslar in the Hartz, at Schwarzenberg in Saxony, in several mines in Schemnitz in Hungary; also in Sweden, in Spain, in different coal mines in England; at Hurlet in Renfrewshire in Scotland. In the United States, numerous localities of Copperas have been discovered, especially in New England, in which section of the country it exists in the form of crusts upon the surfaces of those mica-slate rocks, which happen to abound in Iron Pyrites.

5. Both the natural and the artificial Copperas are used in dyeing, in making ink and Prussian blue, and also for producing sulphuric acid; the residue from the distillation being red oxide of iron, is employed as a color, and for a polishing substance.

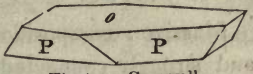
COPPER MICA. Rhombohedral Euchlore-Mica. MOHS.

Primary form. Rhomboid. P on P=69° 30′.

Secondary form.

The annexed figure is the primary, having the summits replaced by single planes.

Fig. 149.



Tingtang, Cornwall.

Cleavage, parallel with P, or the primary, only in traces; but parallel with *o*, with great ease. Surface, *o* smooth, sometimes striated in triangular directions. P often a little uneven.

Lustre pearly upon *o*, both as faces of cleavage, and as faces of crystallization. The faces P possess a lustre intermediate between vitreous and adamantine. Color, emerald-green and grass-green. Streak emerald-green to apple-green, rather paler than the color. Transparent... translucent.

Sectile. Hardness = 2·0. Sp. gr. = 2·5488.

Compound Varieties. Massive: composition granular of various sizes of individuals; faces of composition uneven and rough.

1. Before the blow-pipe, it loses both color and transparency, emits fumes of arsenic, and is changed into a friable scoria, containing some white metallic globules. With borax it yields a green globule, and is partly reduced. In nitric acid, it is soluble without effervescence.

2. *Analysis.*

By Chenevix.

Oxide of copper . . .	49·00
Arsenic acid . . .	14·00
Water . . .	35·00

3. The present species occurs in copper veins, along with various other ores of copper, particularly with the Liroconite, and with Brown Iron-Ore and Quartz.

4. It is found only in some of the copper mines near Redruth in Cornwall; and in minute crystals at Herrengrund in Hungary.

COPPER NICKEL. Cupreous Eruthleucone-Pyrites.

Massive: composition granular, individuals being small, and strongly connected: reniform, composition columnar, generally impalpable. Fracture uneven.

Lustre metallic. Color copper-red. Streak pale brownish-black.

Brittle. Hardness = 5·0 ... 5·5. Sp. gr. = 7·655.

1. Before the blow-pipe, it melts upon charcoal, and emits an arsenical smell. The remaining metallic bead is white and brittle. In nitric acid, it soon becomes covered with a green coating. It is soluble in nitro-muriatic acid.

2. *Analysis.*

By PFAFF.

Nickel	44·206	(with a little cobalt.)		48·96
Arsenic	54·726			46·42
Iron	0·337			0·34
Lead	0 320			0·56
Sulphur	0·401			0·80

3. The Copper Nickel chiefly occurs in veins in various classes of rocks, occasionally occurring in them as beds. It is almost always accompanied by Smaltine; sometimes also by ores of silver and lead, and often invested by Nickel-ochre.

4. The present species is found in veins at Schneeberg, Annaberg, Marienberg, Freiberg, Gersdorf and other places in Saxony; at Joachimsthal in Bohemia; at Saalfeld in Thuringia; at Riegelsdorf in Hessia; in the Hartz and Black Forest; also at Allemont in Dauphiny, and in several of the mines of Cornwall. In beds, it occurs at Schladming in Upper Stiria, and in the neighborhood of Orawitza, in the Bannat. It occurs in the United States at Chatham in Connecticut, accompanied by Smaltine in gneiss.

5. DOEBEREINER has observed that the metallic alloy, consisting chiefly of arsenic and nickel, which is obtained from the process of fabricating smalt, often crystallizes in four-sided tabular crystals, and is in every respect similar to Copper Nickel.

CORDIERITE. (See *Iolite*.)

CORNEOUS LEAD. Kerasine Lead-Baryte.

Primary form. Right square prism.

Secondary form. The primary form having its lateral and terminal edges replaced by single planes.

Cleavage, parallel to the lateral planes of the primary; cross fracture conchoidal.

Lustre adamantine. Color white and pale tints of grey, yellow and green. Streak white. Transparent to translucent.

Sectile. Hardness below 3·0. Sp. gr. =6·056.

1. Before the blow-pipe, it melts quickly into a yellow globule, which becomes white and crystallizes upon the surface, when cooling. Upon charcoal, it is reduced.

2. *Analysis.*

By Klaproth.		By Berzelius, fr. Mendip.
Oxide of lead 85·5	Lead	25·85
Muriatic acid 8·5	Oxide of lead	57·07
Carbonic acid 6·0	Carbonate of lead	6·25
Chlorine 0·0		8·84
Silica 0 0		1·46
Water 0·0		0·54

3. It is found at the Mendip hills in Somersetshire, at Matlock in Derbyshire, Hausbaden near Badenweiler in Germany, and in the United States at Southampton, (Mass.)

CORUNDUM. Rhombohedral Corundum. Mohs.

Primary form. Rhomboid. P on P′=86° 4′.

Secondary forms. 1. Regular six-sided prism. 2. The same, having the terminal edges replaced. 3. Dodecahedron with isosceles-triangular faces, the upper pyramid inclining to the lower under 121° 34′. 4. The same, with the summits replaced by single planes.

Corundum.

Fig. 150.

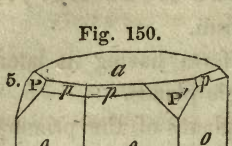
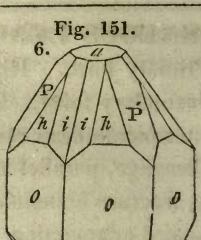


Fig. 151.



P on P′	-	-	= 86°	4′	
P on *a*	-	-	122	30	
P on *o*	-	-	137	30	
p on *o*	-	-	151	30	
p on *a*	-	-	118	30	
o on *a*	-	-	90	00	PHILLIPS.
p on P	-	-	154	7	
h on *h*	-	-	128	20	
h on *a*	-	-	118	56	
h on *o*	-	-	151	17	
P on *h*	-	-	154	2	

Cleavage parallel with *a* perfect: but sometimes interrupted by conchoidal fracture. The faces obtained in the direction of P are commonly the result of composition. The faces of cleavage and regnlar composition are striated parallel to their common edges of intersection. Fracture conchoidal to uneven. Surface *a* striated parallel to the edges of combination with P. The isosceles pyramids are often deeply striated in a horizontal direction.

Lustre vitreous, much inclining in some varieties to pearly upon *a*. Color, blue, red, green, yellow, brown, grey and white. Some of the blue, red and yellow colors, very lively and beautiful. Streak white. Transparent . . . trans-

lucent. In several varieties, if cut round, a six-sided opalescent star is observable in the direction of the axis.

Hardness = 9·0.

Sp. gr. = 3·979, blue, transparent (Sapphire.)
3·949, green, translucent (Corundum.)
3·921, brown, faintly translucent (Adamantine-Spar.)
3·909, red, transparent (Ruby.)

Compound Varieties. Regular composition parallel to one or more faces of P, repeated in parallel layers, very frequent. Massive: composition granular, often impalpable, and then the fracture becomes splintery and uneven.

1. Most of the transparent simple varieties have been designated *Sapphire*, while the compound ones have been called *Emery*. The varieties of Sapphire, generally possess an indistinct cleavage, and a conchoidal fracture; the surface of its crystals is smooth, though not always even. The remaining varieties differ almost only in color,—*Corundum*, comprehending those whose color is green, blue or red, and in most cases inclining to grey, while those of *Adamantine-Spar* are hair-brown and reddish-brown. Both of them are easily cleavable, or at least show faces of composition parallel to the primary form; and the crystals possess a rough and uneven surface. There are many crystals, part of which is Sapphire and part Adamantine-Spar.

Before the blow-pipe it is infusible, whether alone or with soda; it is with difficulty soluble in borax, and if previously reduced to powder, also, in salt of phosphorus. It is not acted upon by acids.

2. *Analysis.*

	By Klaproth.		By Tennant.
	Sapphire.	Corundum.	Emery.
Alumina	98·50	89·50	86·00
Silica	0·00	5·50	3·00
Oxide of iron	1·00	1·25	4·00
Lime	0·50	0·00	0·00

3. Corundum is found in imbedded crystals, and in massive varieties. Sapphire is chiefly met with in the sands of rivers, and is accompanied

by crystals and grains of Magnetic Iron-Ore, and several species of gems. The variety Corundum occurs in imbedded crystals in a rock, which consists, according to BOURNON, of Feldspar and Fibrolite, several species of gems and Magnetic Iron-Ore. Adamantine-Spar occurs with Magnetic Iron-Ore and Fibrolite (Kyanite) in a sort of granite, containing no Quartz. Some varieties have been found imbedded in compact Feldspar, Magnetic Iron-Ore, Calcareous-Spar and talcose-slate.

4. The finest varieties of Sapphire come from Pegu, where they occur in the Capelan mountains near Syrian. It has also been found at Hohenstein in Saxony, at Bilin in Bohemia, at Puy in France, and in several other countries. Corundum occurs in the Carnatic in the East Indies; Adamantine-Spar in the neighborhood of Canton in China, and on the coast of Malabar. In St. Gothard, red and blue varieties exist imbedded in dolomite. Those from Gellivara in Sweden, imbedded in Magnetic Iron-Ore, are of a yellowish-white color. Emery is found in the higher part of Saxony, in the mountain called Ochsenkopf near Schneeberg, and is of a dark blue color, inclining to grey; it approaches to the appearance of blue Corundum, whenever its individuals are of considerable size. In the island of Naxos, and in several other islands of the Greek Archipelago, also at Smyrna, Emery is found in large boulders on the surface of the earth, mixed with other minerals.

Very beautiful blue Corundum is found at Newton, (N.J.) disseminated through an aggregate of brown Hornblende, Mica, Feldspar, Tourmaline, Iron Pyrites, Talc and Calcareous-Spar, the whole of which is connected with an extensive bed of white limestone. The majority of the specimens are found in detached boulders of various sizes, distributed through the soil in a kind of basin, or valley of moderate extent, between two small limestone ridges. The crystals of Corundum are often several inches in length, though deficient in perfection of form. They are also found loose in the soil. Very well defined crystals of Corundum of a bluish, and also of a pink color, are found under somewhat similar circumstances in the vicinity of Warwick, (N.Y.) where they sometimes occur in cavities of large crystals of Spinel. Pale blue crystals of this species occur in Connecticut at West Farms, near Litchfield, associated with Kyanite; and single crystals have been found loose in the soil in the State of North Carolina.

5. The pure and transparent varieties of Corundum, when finely colored, are in great estimation as ornamental stones. The red varieties are most highly valued; and go by the name of *Oriental Ruby*. The violet-blue are called *Oriental Amethyst*, the green *Oriental Emerald*,

Couzeranite.

the yellow *Oriental Topaz*, and the blue *Oriental Sapphire*. *Asteria* is a variety of Sapphire, not perfectly transparent, and shewing a star-like opalescence in the direction of the axis, if cut in oval. Much use is made of Corundum and Adamantine-Spar, particularly in India and China, for cutting and polishing steel and gems, and it is said even of Diamond, which has given occasion to the name of Adamantine-Spar. Emery yields a well known polishing material.

Cottunite.

In acicular crystals.
Lustre adamantine, shining.
Color white.

1. Before the blow-pipe, on charcoal, it melts very easily, coloring the flame blue, and affords a white smoke, which adheres to the coal, turns into greenish yellow flakes, and is chiefly converted into metallic lead. Heated in a matrass, it melts and sublimes. It dissolves in water; and the nitrate of silver throws down from the solution, a precipitate of chloride of silver.

2. *Analysis.*

Chlorine	25·48
Lead	74·52

3. Its locality is believed to be Mount Vesuvius.

4. Additional information is requisite before we can pronounce with confidence as to its specific rank.

Couzeranite.

Primary form. Oblique rhombic prism. M on M = 96°. P on M = 92 or 93°.
Cleavage parallel with the shorter diagonal.
Lustre vitreous. Color greyish black, black and indigo-blue.
Hardness = 7·0. Sp. gr. = 2·6 . . . 2·7.

1. Heated before the blow-pipe, it fuses into a white enamel.

2. *Analysis.*
By Dufresnoy.

Silica	52·37
Alumina	24·02
Lime	11·85
Magnesia	2·40
Potash	5·52
Soda	3·96

3. It is found in many places in the Pyrenees, but chiefly comes from the valley of Vicdessos, passage of Aulus, at the bridge of the Taule, &c.

4. Further investigation is necessary to establish it as a distinct species. It resembles Feldspar.

CRICHTONITE. Axotomous Iron-Ore. Mohs.

Primary form. Rhomboid. P on P = 85° 59′.

Secondary forms.

Fig. 152.

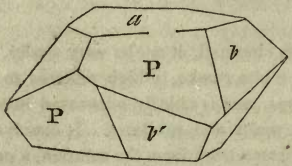


Fig. 153.

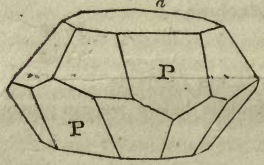
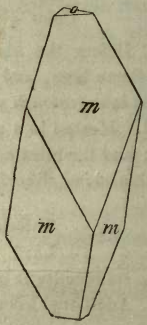


Fig. 154.



P on P	-	-	-	85°	59′
P on *a*	-	-	-	127	40
P on *b*	-	-	-	128	1
P on *b′*	-	-	-	122	28
m on *m*	-	-	-	61	20
m on *o*	-	-	-	97	12

Irregular forms and grains.

Cleavage, perfect parallel to *a*, less distinct parallel with P, and not always observable. Fracture conchoidal. Surfaces generally more rough than smooth, and nearly all of them alike.

Crichtonite.

Lustre imperfectly metallic. Color dark iron-black. Streak black. Opake.

Brittle. Hardness = 5·0 ... 5·5 Sp. gr. = 4·661.

Compound Varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel to *a*: angle of revolution = 60°. (See fig. 129.)

The compositions of this kind hitherto observed are not quite regularly formed, but consist generally of several alternating laminæ. The situation of the individuals is, however, recognizable from the direction of their faces.

1. The foregoing description is principally derived from the species *Axotomous Iron-Ore* of MOHS, under which it is believed that the *Crichtonite* falls; and within the present species also must be included the *Ilmenite* of Prof. KUPFER, who describes it as occurring in variously modified oblique four-sided prisms, and as having a black color, brownish streak, shining lustre and a conchoidal fracture; without cleavage, fragments sharp-edged and opake. Hardness = 4. Sp. gr. = 4·75.

2. Alone before the blow-pipe, it does not suffer any alteration whatsoever. With the fluxes it acts in general like pure oxide of iron; but when dissolved in salt of phosphorus and the glass is reduced, there appears as the color of the oxide of iron vanishes, a more or less distinctly red color, the depths of the color depending upon the relative quantity of the titanium in the variety employed.

3. *Analysis.*

Variety *Ilmenite.*

Titanic acid . . .	46·67
Oxide of iron . . .	47·08
Oxide of manganese . . .	2·39
Magnesia . . .	0·60
Lime . . .	0·25
Oxide of chrome . . .	0·38
Silica . . .	2·80

4. It occurs in imbedded grains and crystals, in several varieties of Mica and dolomite, in the valley of Gastein in Salzburg, and frequently along with the crystals of Rutile, over which it often forms a black coating, as at Kluttau in Bohemia, in the gold streams of Ohlapian in

Transylvania, &c. The only locality of the *Crichtonite* variety is the department of the Isère in France, where it occurs in narrow veins along with Anatase.

The variety Ilmenite is found in the Ilmen mountains in the Urals.

The black metallic crystals found accompanying the Spinel, Brucite, Rutile, &c., imbedded in Serpentine and white limestone at Amity (N.Y.) belong to the present species. They have the form denominated *Fer oligiste imitatif* by HAUY. They are distinguished from Specular Iron by color, fracture, streak, and a diminished specific gravity. It also occurs in broad laminated, imperfectly hexagonal masses, at Washington, (Conn.) imbedded in a vein of Quartz, traversing primitive rocks and likewise in the eastern part of the same state.

5. The Crichtonite presents us in its crystallization a nearer approximation to perfect isomorphism with Specular Iron, than exists between any other two species where the composition is equally diverse.

CRONSTEDITE. Rhombohedral Iron-Mica

Primary form. Rhomboid, of unknown dimensions.

Secondary form. Hexagonal prism.

Cleavage, parallel with terminal planes of the hexagonal prism perfect; with the lateral, imperfect.

Lustre vitreous. Color brownish-black. Streak dark leek-green. Opake.

Thin laminæ are elastic. Hardness = 2·5 nearly. Sp. gr. = 3·348.

Compound Varieties. Reniform and massive: composition columnar.

1. Before the blow-pipe, it froths a little without melting: with borax, it yields a black, opake and hard bead. Reduced to powder, it gelatinizes in concentrated muriatic acid.

2. *Analysis.*

By STEINMANN.

Silica	22·452
Oxide of iron	58.853
Oxide of manganese	2·885
Magnesia	5·078
Water	10·700

Cryolite.

3. It occurs at Przibram in Bohemia, in veins containing silver-ores, along with Brown Iron-Ore, Spathic Iron, White Iron-Pyrites and Calcareous Spar. It has also been found at Wheal Maudlin in Cornwall.

CRYOLITE. Prismatic Cryone-Haloide. Mohs.

Primary form. Right-rectangular prism. C.

Cleavage, parallel with P perfect, with M and T less perfect, or coherent. Fracture imperfect or conchoidal, uneven.

Lustre vitreous, a little inclining to pearly upon the faces of P. Color white, sometimes verging upon red or yellowish-brown. Streak white. Semi-transparent... translucent. On account of its low refractive power, it appears more transparent when immersed in water.

Brittle. Hardness = 2·5 ... 3·0. Sp. gr. = 2·963 of a white variety.

Compound Varieties. Massive: composition granular, the individuals being of considerable size.

1. It is very fusible, and melts even in the flame of a candle. Before the flame of the blow-pipe, it is first perfectly liquified; but soon becomes hard again, and assumes at last a slaggy appearance. It is insoluble in water, though it suffers cleavage more readily after having been immersed in it for some time.

2. *Analysis.*

	By Klaproth.	By Vauquelin.
Alumina	21·0	24·0
Soda	32·0	36·0
Fluoric acid and water	47·0	40·0

3. It occurs at Arksut-fiord, (West Greenland,) in two small layers in gneiss, one of which contains only the white varieties, whereas the other contains the colored ones, accompanied by Galena, Iron-Pyrites, Spathic Iron and Feldspar.

CUBE-ORE. Hexahedral Malachite-Haloide.

Primary form. Cube.

Secondary forms.

1. The cube with the alternate solid angles replaced by triangular planes.

2. The same, but replaced by four planes, three of which rest upon the primary edges, the fourth upon the apex of the new planes.

3. The cube with its edges and angles truncated.

Cleavage, parallel with the primary form difficult and imperfect. Fracture conchoidal, uneven. Surface of the cube sometimes streaked parallel to the edges of the secondary faces situated upon the solid angles. The other faces, with the exception of the secondary planes situated upon the edges of the cube, often curved.

Lustre adamantine, not very distinct. Color olive-green, passing into yellowish-brown, bordering sometimes upon hyacinth-red and blackish-brown; also into grass green and emerald green. Streak, olive-green ... brown, commonly pale. Translucent on the edges.

Rather sectile. Hardness = 2·5. Sp. gr. = 3·000.

Compound Varieties. Massive: composition granular, rare.

1. Exposed to a gentle heat, its color is changed into red. In a higher degree of temperature, it intumesces, gives little, or no arsenic, and leaves a red powder. Upon charcoal, it emits copious fumes of arsenic, and melts in the inner flame into a metallic scoria, which acts upon the magnetic needle.

2. *Analysis.*

	By Chenevix.	By Vauquelin.
Oxide of iron	45·50	48·00
Arsenic	31·00	18·00
Oxide of copper	9·00	0·00
Silica	4·00	0·00
Carbonate of lime	0·00	2·00
Water	10·50	32·00

3. Cube-Ore is chiefly found in veins of copper ores in the older classes of rocks, where it is accompanied by Vitreous Copper, Fahlerz, White Iron-Pyrites and Quartz.

4. It is principally found in Cornwall, in several copper-mines, in the neighborhood of Redruth, but has also been found at St. Leonhard in France, and at Schwarzenberg in Saxony.

In the United States, it has been met with in drusy coatings, along with Mispickel, Iron, and Copper Pyrites, at Edenville in Orange county, (N.Y.) where these minerals exist in gneiss; and under similar circumstances in Derby, (Conn.)

CUMMINGTONITE. Hemi-prismatic Wavelline-Spar?

Massive: composition thin columnar, scopiform and stellular, rather incoherent; fibres somewhat curved.

Cleavage parallel to an oblique rhombic prism.

Lustre silky, color ash-grey. Translucent to opake.

Brittle. Hardness = 6·5. Sp. gr. = 3·2014.

1. Alone before the blow-pipe, it is infusible, except on very thin edges. With carbonate of soda it fuses with effervescnce into a dark glass. With borax it fuses into a black glass.

2. *Analysis.*

By Muir.

Silica - - - -	56·543
Protoxide of iron - - -	21.669
Protoxide of manganese - -	7·802
Soda - - - -	8·439
Volatile matter - - - -	3·178

3. Cummingtonite is found at Plainfield and Cummington, (Mass.) in mica-slate, associated with Garnet and White Iron-Pyrites.

CUPREOUS ANGLESITE. Cupreous Lead-Baryte.

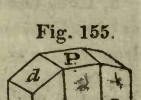
Primary form. Right oblique-angled prism. M on T = 102° 45′.

Secondary form.

M on T	-	-	102°	45′
P on *f*1	-	-	90	00
T on *f*1	-	-	161	30
M on *d*	-	-	120	30

Brooke.

Fig. 155.



Cleavage, parallel to M and T very perfect. Surface generally smooth and shining, some of the faces rough.

Lustre, adamantine.

Color deep and beautiful, azure-blue. Streak, pale blue. Faintly translucent.

Rather brittle. Hardness =2·5 . . . 3·0. Sp. gr.=5·30 . . . 5·43. Brooke.

1. *Analysis.*

By Brooke.

Sulphate of lead	-	-	-	74·4
Oxide of copper	-	-	-	18·0
Water	-	-	-	4·7

2. It is found along with other ores of lead, at Lead Hills in Scotland: also at Linares in Spain.

CUPREOUS BISMUTH. Prismatoidal Polypoione-Glance.

Crystalline. Primary form not known; probably prismatic. Massive: composition columnar, the individuals being long and slender; also impalpable.

Cleavage, in one direction parallel with the prismatic axis. Fracture uneven, or imperfectly conchoidal.

Lustre metallic. Color steel-grey, light copper-red, passing to yellowish. Streak blackish grey.

Hardness =2·0 . . . 2·5. Sp. gr. =6·125.

1. It melts very easily before the blow-pipe, coloring the flame of the lamp, blue; and leaving, after the fumes have subsided, a whitish, or sul-

phur, yellow slag, which, on being heated with soda, yields metallic copper. The powder is dissolved in nitric acid, with evolution of red fumes, and the precipitation of sulphur and sulphate of lead. The solution affords with water a white precipitate of oxide of bismuth, or with sulphuric acid, one of sulphate of lead.

2. *Analysis.*

	By John, from Ecatherineburg.	By Klaproth, from Baden.
Sulphur	11·58	16·3
Bismuth	43·20	27·0
Lead	24·32	33·0
Copper	12·10	0·9
Nickel	1·58	0·0
Tellurium	1·32	0·0
Silver	0·00	15·0
Iron	0·00	4·3

3. It is found in the mines of Pyschminskoi and Klutschefskoi in the district of Ecatherineburg in Siberia, in Quartz, accompanied by Native Gold and Galena. The variety analyzed by Klaproth occurs in Quartz and Fluor, with Iron Pyrites, Copper Pyrites and Galena, at Schapbach in Baden.

Appendix to Cupreous Bismuth.

i. *Cupreous Sulphuret of Bismuth.*

Crystalline in fibrous masses and capillary crystals.

Lustre metallic. Color light steel-grey to tin-white. Streak white.

1. *Analysis.*

By Klaproth.

Sulphur	12·58
Bismuth	47·24
Copper	34.66

2. It occurs at Gallenbach in the principality of Fürstenberg, in a disintegrated granite with Heavy Spar, Native Bismuth and Copper Pyrites.

CUPREOUS MANGANESE. Staphyline Manganese-Ore.

Small reniform and botryoidal groupes, massive. Composition impalpable. Fracture imperfectly conchoidal.

Cupreous Manganese—Datholite.

Lustre resinous. Color bluish-black. Streak unchanged. Opake.

Hardness = 3·5. Sp. gr. = 3.197 . . . 3·216.

1. Before the blow-pipe, it becomes brown, but is infusible. To borax and salt of phosphorus, it communicates the colors of copper and manganese. 2. *Analysis.*

By LAMPADIUS.

Black oxide of manganese . .	82·00
Brown oxide of copper . .	13·50
Silica . .	2·00

BERZELIUS found it to contain a considerable quantity of water.

3. It occurs in the tin mines at Schlaggenwald in Bohemia, and at Armarilla in Chili.

CYANITE. (See *Kyanite.*)

CYMOPHANE. (See *Chrysoberyl.*)

CYPRIN. (See *Idocrase.*)

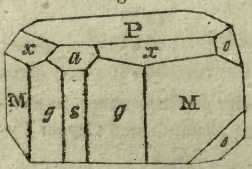
DAVYNE. (See *Nephiline.*)

DATHOLITE. Prismatic Dystome-Spar. MOHS.

Primary form. Right rhombic prism. M on M′ = 102° 30′.

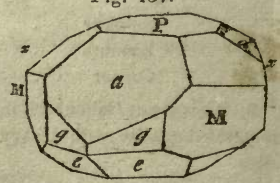
Secondary forms.

Fig. 156.



Arendal.

Fig. 157.



Seiseralp.

M on M	-	= 77°	30′	x on x	-	122°	00′
g on g	-	116	9	x on d	-	115	45
P on s	-	90	00	x on o	-	177	04
P on a	-	136	04				

Datholite.

Cleavage, very indistinct parallel to *s*, but somewhat more easily observed parallel to P. Fracture uneven, imperfectly conchoidal. Surfaces, several faces much streaked, and others altogether rough.

Lustre vitreous, and particularly in the fracture inclining to resinous. Color white, inclining to green, yellow, and grey; sometimes of a dirty olive green, or honey-yellow tinge. Streak white, more or less translucent.

Brittle. Hardness = 5·0 . . . 5·5. Sp. gr. = 2·989, a variety from Arendal.

Compound Varieties. Botryoidal and implanted globular shapes, surface drusy, composition columnar. Massive: composition columnar, consisting of delicate, straight and generally diverging individuals, radiating from a centre; also granular, of various sizes of individuals, faces of composition rough and irregularly streaked.

1. Owing to the variation of position in which the crystals of this species were at first described, they were referred to two different species, *Datholite* and *Humboldtite*, the latter of which is now abandoned. Still another species or sub-species, according to some authors, the *Botryolite*, requires also to be united with Datholite. It embraces the reniform and globular shapes, consisting of thin individuals; but specimens have lately been discovered, which clearly prove, by transition, their connexion with Datholite.

Exposed to the flame of a candle, it becomes friable; before the blowpipe, it loses its transparency, intumesces, and melts into a glassy globule. It is easily soluble in nitric acid, and leaves a siliceous jelly.

2. *Analysis.*

By KLAPROTH.

	of *crystals.*	of *Botryolite.*
Silica	36·50	36·00
Lime	35 50	39·50
Boracic acid	24 00	13·50
Oxide of iron	0·00	1·00
Water	4·00	6·50

3. It occurs in beds of iron-ore, in primitive rocks, accompanied by Calcareous Spar; sometimes also by Fluor, Hornblende, Quartz and Prehnite: with the latter species, and several others of the Zeolite family, it is found in agate balls and irregular veins in trap-rocks.

4. Upon the beds of iron-ore at Arendal in Norway, are found the varieties of Datholite and Botryolite. The Humboldtite occurs in agate balls in the Seiseralp in the Tyrol, and in irregular veins in greenstone in Salisbury-craig near Edinburgh.

In the United States, in New Jersey at Paterson, the Datholite has been met with in large and well defined forms, in trap; and at Middlefield in Connecticut, the variety Humboldtite occurs under similar circumstances, and in cavities; also on Mt. Carmel, at Hamden, (Conn.) with Prehnite.

DERMATIN. (See *Kerolite.*)

DEWEYLITE. (See *Kerolite.*)

DIALLOGITE. Macrotypous Parachrose-Baryte. MOHS.

Primary form, a rhomboid. P on P=106° 51′.

Secondary form, the primary having the upper edges replaced by tangent planes.

Cleavage, parallel to the primary form. Fracture uneven, imperfectly conchoidal. Surface streaked parallel with the edges of the new planes, thus producing lenticular crystals.

Lustre vitreous, inclining to pearly. Color various shades of rose-red, partly inclining to brown. Streak white. Translucent in different degrees.

Brittle. Hardness =3·5. Sp. gr. =3·592 of the crystallized variety from Kapnik.

Compound Varieties. Globular and botryoidal shapes: surface sometimes smooth, at other times rough; composition columnar, often indistinct. Massive: composition granular, sometimes small, and even impalpable; sometimes it is columnar.

Diallogite.

1. The varieties of the present species have often been confounded with other minerals, one of which has been proposed by BREITHAUPT as a distinct species, an account of which will be given at the close of this description.

Before the blow-pipe, its color is changed into grey, brown and black, and it decrepitates strongly; but is infusible without addition. It is easily fusible in glass of borax, which thereby becomes of a violet blue color. If exposed to the air, its natural color is changed into brown. Many bright rose-red varieties become paler on being exposed in a similar manner. It effervesces briskly in nitric acid.

2. *Analysis.*

	By DUMENIL.	By BERTHIER, fr. Nagyag.
Oxide of manganese	54·60	56·00
Carbonic acid	33·75	38·60
Oxide of iron	1·87	0·00
Silica	4·37	0·00
Lime	2·50	5·40

3. It occurs for the most part in metalliferous veins, with various ores of Iron and Copper, and with Quartz. It is also found in beds with other minerals containing manganese.

4. It is found in several of the Saxon mines, particularly in the neighborhood of Freiberg; also at Nagyag and Kapnik in Transylvania, near Elbingerode in the Hartz, and in other countries.

i. *Manganeseous Carbon-Spar.* BREITHAUPT.

P on P = 107° 30′.

Cleavage parallel to the primary, easily effected.

Hardness (scale of BREITHAUPT) = 5·75...6·0. Sp. gr. = 3·592.

BREITHAUPT includes in this species the mineral from Kapnik only. This variety was analyzed by BERTHIER, and found to contain,

Carbonic acid	30·4
Protoxide of manganese	41·0
Lime	4·3
Quartz	21·0
	96·7

DIAMOND. Octahedral Diamond. Mohs.

Primary form. Regular octahedron.

Secondary forms.

1. Primary form, having its solid angles replaced by tangent planes.

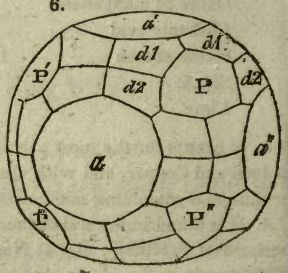
2. Primary form, having its edges replaced by tangent planes.

3. Cube.

4. Cube, having its edges replaced by tangent planes.

5. Rhombic dodecahedron.

Fig. 158.



The annexed figure represents in planes P P′ P″ and P‴ the primary faces of the octahedron, and in *a* *a′* *a″* those of the cube, which are generally flat and brilliant. The numerous faces *d*1 and *d*2, are uniformly convex; each of which is, in reality, a series of planes, as is manifest on other crystals, but in no instance sufficiently perfect for the use of the reflective goniometer.

Irregular forms and grains.

Cleavage, parallel with the primary octahedron, perfect. Fracture, conchoidal. Surface, the octahedron sometimes faintly streaked parallel to its edges of combination, but in general very smooth. Also the dodecahedron, if often streaked, rough and uneven; the tetraconta-octahedron, curved and smooth. Grains possess a rough and granulated surface.

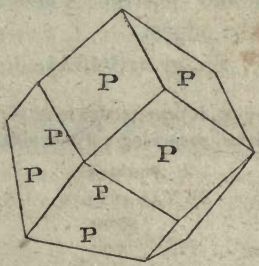
Lustre bright adamantine. Color white, prevalent; also various shades of blue, red, yellow, green, brown, grey,

and even black. Generally pale. Streak white. Transparent... translucent, dark colored varieties only on their edges. If cut and polished, it shows a most lively play of color.

Hardness = 10·0. Sp. gr. = 3·520, of a white variety.

Compound Varieties. Twin-crystals. Axis of revolution perpendicular to a face of the octahedron; angle of revolution = 60°. (See fig. 50.) Also, axis of revolution parallel to one of the axes of the rhombic dodecahedron which passes through the obtuse solid angles. (See the annexed figure.) Angle of revolution = 60°.

Fig. 159.



1. Diamond is perfectly combustible at a temperature of about 14° Wedgewood, and yields with oxygen, carbonic acid gas. It is not acted upon by acids or alkalies.

2. The rocks hitherto considered as the gangue of Diamond are secondary ones, as several kinds of sandstone, consisting of aggregated quartz pebbles. It is also found in strata of iron-shot sand and clay, and in the loose sand of plains and rivers. In a specimen from Brazil, in the possession of Mr. HEULAND, it is associated with Skorodite, and imbedded in a compact variety of Brown Iron-Ore.

3. The Diamond was first discovered in the East Indies, where it has been worked for many centuries, and in Brazil. They are found in various places on the eastern coast of the British peninsula in India, but particularly between Golconda and Masulipatam; also near Panna in Bundelcund. It also occurs in the peninsula of Malacca, and the isle of

Borneo. In Brazil, they occur in the district of Serro do Frio in the capitania of Minas Geraes, and were first discovered in the Riacho Fundo, then in the Rio do Peixe, and also in the Terra de St. Antonio.

4. Diamond is the most valuable of all the gems. It is employed also in cutting glass, and for engraving, cutting and polishing other hard stones, and the Diamond itself.

DIASPORE. Tetarto-prismatic Wavelline-Spar?

Primary form. Doubly oblique prism, according to PHILLIPS. M on T=64° 54′. P on T=101° 20′. P on M=108° 30′. According to MOHS, it is a rhombic prism of about 130°.

Lustre vitreous and pearly. Color greenish-grey.

Translucent on the edges.

Scratches glass. Sp. gr.=3·4324.

1. Before the blow-pipe, it decrepitates most violently, and splits into many small scaly particles, possessing a feeble alkaline reaction.

2. *Analysis.*

	By VAUQUELIN.	By CHILDREN.
Alumina	80·00	76·06
Protoxide of iron	3·00	7·78
Water	17·30	14·70

BERZELIUS is of opinion that besides these, it also contains some alkaline substance.

3. Its locality is unknown.

4. Its reference to the genus Wavelline-Spar is made with hesitation, from the limited knowledge possessed of its properties. Unless some clue to the discovery of its locality shall ere long be made, it will become doubtful whether it is not an artificial production.

DICHROITE. (See *Iolite.*)

DIOPSIDE. (See *Pyroxene.*)

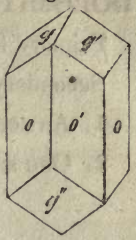
DIOPTASE. Rhombohedral Copper-Baryte.

Primary form. Rhomboid. P on P=126° 17′.

Dioptase.

Secondary form.

Fig. 160.



g on g'	- -	95°	33′
o' on o or o	- -	120	04
g on o, or g' on o'	-	173	00

Cleavage, parallel with the primary form, perfect. Fracture conchoidal, uneven.

Lustre vitreous, inclining to resinous. Color emerald green, also blackish-green, and verdigris-green. Streak green. Transparent . . . translucent.

Brittle. Hardness = 5.0. Sp. gr. = 3·278.

1. It decrepitates before the blow-pipe, and upon charcoal it becomes black in the exterior flame, and red in the interior one, without melting. It is easily soluble in glass of borax, and imparts to it a green color. It is soluble without effervescence in muriatic acid.

2. *Analysis.*

	By Lowitz.	By Vauquelin.
Oxide of copper - -	55·00 - -	25·57
Carbonate of lime - -	0·30 - -	42·85
Silica - -	33·00 - -	28·57
Water - -	12·00 - -	0·00

3. It has been found accompanied by Green Malachite and Calcareous Spar, but the nature of its original repositories is not known. It occurs in the Kirghese steppes in Siberia. Minute crystals are said to accompany the Electric Calamine of Rezbanya in Hungary.

Diploite. (See *Latrobite.*)

Dipyre. (See *Scapolite.*)

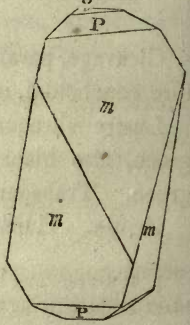
DOLOMITE. Macrotypous Lime-Haloide.

Primary form. Rhomboid. P on P = 106° 15′.

Secondary forms.

1. An acute rhomboid of 79° 36′ from Gotha in Saxony.
2. One still more so, of 66° 7′, from Hall, Tyrol.

Fig. 161.



3. The same, having its summits surmounted by three pyramidal faces of the primary rhomboid, whose apices are replaced by tangent planes, as in the annexed figure.

Cleavage, parallel with the primary rhomboid, perfect, with traces of a cleavage at right angles to the vertical axis. Fracture conchoidal. Surface, faces *m* streaked parallel to the edges of combination with P. The rest of the faces generally smooth, and of nearly the same physical quality.

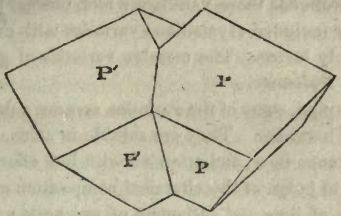
Lustre vitreous, inclining to pearly in several varieties. Color white, seldom pure, generally inclining to red or green. Various shades of red, among which is a fine rose-red. Also green, brown, grey, black, very often owing to foreign admixtures. Streak, greyish-white. Semi-transparent . . . translucent.

Brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 2·884, a greenish white cleavable variety, from Mexico.

Dolomite.

Compound Varieties. Twin-crystals.

Fig. 162.



Piedmont.

Sometimes variously repeated. Implanted globules; botryoidal, fructicose, and other imitative shapes: surface drusy and rough, composition columnar. Massive: composition granular, of various sizes of individuals, generally easily distinguishable, and often but slightly cohering. The composition is often columnar, also of different sizes of individuals. These compositions are again variously compounded, as the granular composition in a coarser kind of granular composition, of which the component particles may be easily separated, and present an uneven surface. It occurs often in crystalline coatings upon other crystals, impressions, &c.

1. The remark which was made under Calcareous Spar, respecting its comprehension of several distinct species, separated from one another by constant differences of form, hardness and specific gravity, may be applied to Dolomite with nearly the same propriety. And the mineralogist there referred to, who has attempted to distinguish those species, has occupied himself also with the varieties of the present species. Some account of his labors will be introduced as an appendix to Dolomite.

The division of this species into sub-varieties and sub-species, according to the older mineralogists, depended upon slight variations of composition, color, lustre, and upon chemical and mechanical mixtures. *Rhomb-spar* and *Bitter-spar* are the names applied to crystallized vari-

eties, provided their faces are not curvilinear or unusually pearly; also to large grained and easily cleavable varieties, chiefly of greenish colors. *Brown-spar* comprehends those varieties which possess a reddish brown color. *Pearl-spar* included crystallized varieties with curved faces, and possessed of a pearly lustre. The massive varieties of granular composition were called *Dolomite*.

Before the blow-pipe, some of the varieties assume a darker color, and a higher degree of hardness. They are soluble in acids, but much more slowly than Calcareous Spar, and attended with less effervescence.

2. It is difficult to judge of the chemical composition of Dolomite. It contains carbonate of lime and carbonate of magnesia; but the relative quantity of the two has not been accurately settled. From several analyses by KLAPROTH, the proportion appears to be nearly as 54·18 : 45·82, which corresponds to

Lime - - - -	30·56
Magnesia - - - -	22·18
Carbonic acid - - - -	47·26

Several analyses of brown-spar give very similar results; others deviate more or less from them. In general, brown-spar seems to contain more oxide of iron and manganese, than either the old varieties dolomite or rhomb-spar.

3. The different varieties of Dolomite differ in respect to their localities. The granular variety (dolomite) constitutes beds in other rocks, and therefore belongs, itself, to the class of rocks. Rhomb-spar occurs in imbedded crystals and compound masses, in several kinds of rocks, particularly in common Talc, and less frequently in compact varieties of gypsum that are mixed with clay. Brown-spar is principally found in metalliferous veins.

4. The variety called Dolomite occurs in St. Gothard, in the Appennines, and in Carinthia; Rhomb-spar in various districts of Salzburg, the Tyrol and Switzerland, at Miemo in Tuscany, (from which the name of *Miemite* has been derived,) and in many other countries; beautiful crystals at Traversella in Piedmont. Brown-spar and Pearl-spar are very frequent at Schemnitz in Hungary, Kapnik in Transylvania, Freiberg and elsewhere in Saxony, at Clausthal in the Hartz, in Norway and Sweden, at Alston Moor in Cumberland, in the greywacke quarries of the same country, in Derbyshire, Baeralston and other places in Devonshire.

Dolomite.

In the U. States the Rhomb-spar variety or bitter-spar, occurs abundantly at numerous places in R. Island, Massachusetts and Vermont, imbedded in common Talc or its variety, steatite; as at Roxbury, (Vt.) where it occurs in large, yellow, transparent crystals, imbedded in greenish transparent Talc; at Smithfield, (R. I.) where it occurs in large grained, easily cleavable individuals, associated with white Talc in Calcareous Spar or limestone, and rarely in very perfect implanted rhomboids of small dimensions. The Pearl-spar exists abundantly both of a white color, and with a delicate pink tinge, at Lockport, (N.Y.) where it is associated with Calcareous Spar, Celestine, and Gypsum in geodes, occurring in transition limestone. The brown-spar is found at numerous places in New York and Ohio, where it occurs in greywackes and secondary limestones, in the form of veins and seams. The massive variety of Dolomite constitutes extensive beds in Litchfield county, (Conn.) and in the south western towns of Massachusetts.

5. Dolomite is often employed as a marble, and rarely in the production of quick lime.

Appendix to Dolomite.

i. *Eumetric Carbon-Spar.* Breithaupt.

P on P = 106° 11′.

Cleavage parallel with P uncommonly perfect and easy.

Hardness = 5·0, (scale of Breithaupt.)

Sp. gr. = 2·9177, a cleavage crystal.

The Eumetric Carbon-Spar embraces only the beautiful twin-crystals, above alluded to, from Traversella in Piedmont.

ii. *Tautoklinous Carbon-Spar.* Breithaupt.

P on P = 106° 10′ 40″.

Cleavage parallel with P perfect.

Hardness = 4·75 . . . 5. (scale of Breithaupt.)

Sp. gr. = 2·9633. } Fragments of cleavage crystals from the
2·9644. } mine of Beschert Glück in Freiberg.

Color reddish, or greyish-white.

It occurs at Freiberg, Johann-Georgenstadt, and probably the brown-spar of Schneeberg belongs to the present species.

iii. *Kryptose Carbon-Spar.* Breithaupt.

P on P = 106° 19′.

Cleavage parallel with P, but not very perfect.

Hardness = 4·50 . . . 4·75. (scale of BREITHAUPT.)
Sp. gr. = 2·809, reddish-white, cleavage crystal.
2·810, brownish red, cleavage crystal.
2·827, dark brownish red and brown, with delicate black stripes; both from Freiberg.

1. It consists, according to KARSTEN, of

Carbonate of lime	96·40
Carbonate of protoxide of manganese	2·10
Carbonate of iron	0·95
Water and loss	0·55

It is found only at two mines in Freiberg.

iv. *Isometric Carbon-Spar.* BREITHAUPT.

P on P = 106° 19′.
Cleavage parallel with P perfect.
Hardness = 5·50 . . . 5·75. (scale of BREITHAUPT.)
Sp. gr. = 2·847, minute, ash-grey crystals in gypsum, from Hall in Tyrol.
2·849, greenish white masses of a compound variety, from Koloseruck in Bilin, (Bohemia,) where it occurs in seams in basalt.
2·853, minute, but possibly not perfectly pure cleavage crystals, of the above variety, from Hall.
2·857, minute, pure, and white cleavage crystals, from Dinz.
2·859, asparagus green, cleavage crystals, from Schweinsdorf. (Tharaudite.)

The variety from Hall afforded, to KLAPROTH,

Carbonate of lime	68·0
Carbonate of magnesia	25·5
Carbonate of protoxide of iron	1·0
Water	2·0
Foreign matter	2·0

DYOXYLITE. Prismatoidal Lead-Baryte. HAIDINGER.

Primary form. Right rhombic prism. M and M′ = 120° 45′.

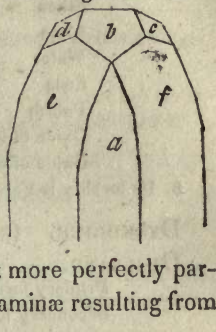
Dyoxylite.

Secondary form.

a on *b*	-	-	111°	00′
b on *b*	-	-	130	00
a on *c*	-	-	106	45
a on *d*	-	-	73	45
a on *e*	-	-	123	20
c on *f*	-	-	133	00
d on *e*	-	-	136	54

PHILLIPS.

Fig. 163.



Cleavage parallel with M and P, but more perfectly parallel with the shorter diagonal. The laminæ resulting from cleavage are flexible, like Gypsum.

Lustre adamantine, inclining to resinous, pearly upon the perfect face of cleavage. Color greenish-white, or yellowish white, sometimes inclining to grey. Streak white. Translucent.

Sectile. Hardness = 2·0 ... 2·5. Sp. gr. = 6·8 ... 7·0.

1. *Analysis.*

By BROOKE.

Carbonate of lead	-	-	-	46·9
Sulphate of lead	-	-	-	53·1

The effervescence while dissolving in nitric acid is scarcely perceptible.

2. It is found in columnarly aggregated crystals, at the Lead hills in Scotland.

DYSCLASITE.

Massive; imperfectly fibrous; the fibres sometimes divergent.

Lustre vitreous. Color white. Translucent. It possesses double-refraction.

Tough. Hardness above Fluor. Sp. gr. = 2·362.

1. Heated to redness, it emits moisture. Before the blow-pipe, it fuses only on the edges. With soda it forms a semi-transparent glass, and with borax and salt of phosphorus it gives colorless glasses. It gelatinizes readily with muriatic acid.

Dysluite.

2. *Analysis.*

By Connell.

Silica - - - -	57·69
Lime - - - -	26·83
Water - - - -	14·71
Soda - - - -	0·44
Potash - - - -	0·23
Oxide of iron - - - -	0·32
Oxide of manganese - - -	0·22

3. Its locality is Faroe.

Dyskolite. (See *Saussurite.*)

Dysluite.

Primary form. Regular octahedron.

Secondary form. Regular octahedron, with its edges truncated.

Cleavage parallel with the primary rather imperfect. Fracture sub-conchoidal. Surface rough.

Lustre vitreous, inclining to resinous. Color yellowish-brown or greyish-brown. Streak paler than the color. Translucent on the edges . . . to opake.

Hardness = 7·5 . . . 8·0. Sp. gr. 4·0 . . . 4·6.

1. Before the blow-pipe, it is infusible.

2. It is found in small quantity, at Sterling, (New Jersey,) disseminated through laminated Calcareous Spar, and associated with Franklinite and Troostite.

3. There is nothing but the unimportant property of color to distinguish this mineral from Automalite, to which it should, without doubt, be referred.

Dysodile.

Massive; compact or laminated. Extremely fragile.

Fracture earthy.

Soft, scratched by the nail. Sp. gr. = 1·1 . . . 1·2.

Color greenish and yellowish, to liver-brown. Streak vitreous. Macerated in water, it becomes translucent, and its laminæ acquire elasticity. When breathed upon, it emits an argillaceous odor.

1. It burns with a considerable flame and smoke, and an almost insupportably fetid odor, leaving a residue of nearly half its weight, and unal-

tered in form. It occurs at Melili, near Syracuse in Sicily, in the form of a bed of inconsiderable thickness, between beds of a secondary limestone.

2. It probably belongs to the species Bitumen, so far as it is a simple mineral.

EARTHY COBALT. Cobaltic Lusine-Ore.

Pulverulent, investing ores of iron and of cobalt, and intermingled with these, and with earthy matters.

Color black.

1. Heated upon charcoal, it gives no arsenical odor; and fused with soda, gives no indication of manganese. With borax, it forms a very intensely blue glass.

2. BEUDANT suggests its composition to be,

Oxygen	28·90
Cobalt	71·10

3. It is probably derived from the decomposition of the arseniurets of cobalt, being found in small quantity with these ores.

4. Its principal localities are Würtemberg, Saalfeld, Joachimsthal and the Tyrol.

5. The *botryoidal* and the *stalactitic Earthy Cobalt*, whose sp. gr. = 2·24, and which afford moisture when heated, and the smell of arsenic, appear to be mixtures of the above mineral with Brown Iron-Ore, some of the ores of cobalt and of manganese, together with accidental earthy ingredients; of which character appear to be the following minerals:

From Riechelsdorf.
Analyzed by KLAPROTH.

Peroxide of cobalt with oxide of manganese	97·0
Oxide of manganese	80·0
Oxide of copper	1·0
Water	85·0
Silica	124·0
Alumina	102·0

From Saalfeld.
Analyzed by DOBEREINER.

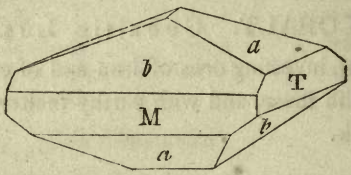
Oxide of cobalt and of manganese	76·9
Water	23·1

EDINGTONITE. Pyramidal Dystome-Spar.

Primary form. Right rectangular prism?

Secondary form.

Fig. 164.



Cleavage, pretty distinct parallel to the primary faces. In other directions a small and conchoidal fracture. Surface, M and T generally smooth, the rest curved and without lustre.

Lustre vitreous. Color greyish white. Semi-transparent, but oftener translucent. Streak white.

Hardness $=4{\cdot}0 \ldots 4{\cdot}5$. Sp. gr. $=2{\cdot}71$.

1. It yields moisture when calcined. It is fusible before the blowpipe into a transparent glass. It gelatinizes in the acids.

2. *Analysis.*

By TURNER.

Silica	35·09
Alumina	27·69
Lime	12·68
Water	13·32

3. It occurs at Kilpatrick near Dumbarton, (Scotland,) where it is accompanied by Harmotome and Thomsonite, being implanted upon the latter mineral in crystals, the largest of which is only two lines in diameter.

EKEBERGITE. (See *Scapolite.*)

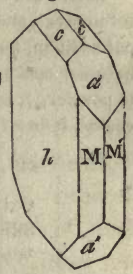
ELAOLITE. (See *Nepheline.*)

ELECTRIC CALAMINE. Prismatic Zinc-Baryte. Mohs.

Primary form. Right rhombic prism. M on M=102° 35′.

Secondary form.

Fig. 165.



M on M	-	-	102°	30′
M on *a*	-	-	132	35
a on *h*	-	-	128	40
a on *c* or *e*	-	-	115	00
c on *c*′	-	-	126	36

Phillips.

Cleavage, parallel with the primary lateral planes, perfect; traces of cleavage parallel with the terminal planes. Fracture uneven. Surface of lateral planes streaked parallel with their common intersections. The rest of the faces generally smooth, sometimes rounded.

Lustre vitreous, inclining to pearly, sometimes to adamantine upon curved faces of crystallization. Color white, prevalent: occasionally blue, green, yellow or brown. Streak white. Transparent . . . translucent.

Brittle. Hardness = 5·0. Sp. gr. = 3·379, crystals from Rossegg in Carinthia.

Compound Varieties. Globular, botryoidal shapes: surface drusy. Massive: composition either granular or columnar; the former of them often impalpable and strongly coherent, and then the fracture becomes uneven; the latter straight and divergent.

Electric Calamine.

1. In some of the crystals of Electric Calamine, dissimilar modifications have been observed upon the opposite extremities of the same crystals, as in Tourmaline; attended also with the evolution of different kinds of electricity, as in that mineral. Like the Tourmaline, the electric excitation is occasioned by common changes of atmospheric temperature; and is not destroyed in the crystals, even after their exposure to a red heat.

Before the blow-pipe, it decrepitates a little, loses its transparency, intumesces, and emits a green phosphorescent light. It is infusible without addition, but is dissolved by borax into a clear glassy globule, which becomes opake on cooling. It is phosphorescent by friction. Reduced to powder, it is soluble in heated sulphuric or muriatic acid, and when cooled, it forms a jelly.

2. *Analysis.*

	By Berthier.	By Berzelius.
Oxide of zinc	66·00	66·37
Silica	25·00	26·23
Water	9·00	7·40

This species has been found artificially produced, lining the throats of iron furnaces, in Salisbury, (Conn.) where the ore employed is the Brown Iron-Ore. The furnaces are constructed of mica-slate. The mineral presents itself in coatings, quarter of an inch in thickness, having botryoidal shapes with drusy surfaces. Its color is a delicate straw-yellow.

3. Electric Calamine is found along with Calamine in veins belonging to various classes of rocks, but chiefly calcareous ones. It is usually associated with Blende and Galena.

4. Considerable quantities occur at Bleiberg and Raibel in Carinthia, Rezbanya in Hungary, Freiburg in Brisgau, Altenberg near Aix-la-Chapelle, near Tarnowitz in Silesia, at Olkuzk and Medziana Gora in Poland and in Siberia. It occurs in Leicestershire, Derbyshire, Flintshire, Somersetshire, &c., in England; at Wanlockhead and Lead-Hills in Scotland.

In the United States, it has of late been discovered in Jefferson co. (Missouri) at a lead mine called Valle's diggings, where it is associated with Calamine.

Emerald. (See *Beryl.*)

Emery. (See *Corundum.*)

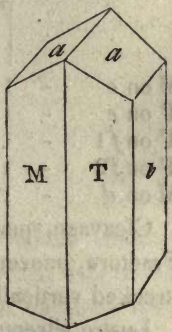
ENDELLIONE. (See *Bournonite.*)

EPIDOTE. Prismatoidal Augite-Spar. MOHS.

Primary form. Right oblique-angled prism. M on T =115° 40′.

Secondary forms.

Fig. 166.



Franconia, (N.H.)

M on T	- -	115°	36′
T on *b*	- -	128	35
b on M′	- -	116	26
a on *a*	- -	109	24
a on *b*	- -	125	32

Fig. 167.

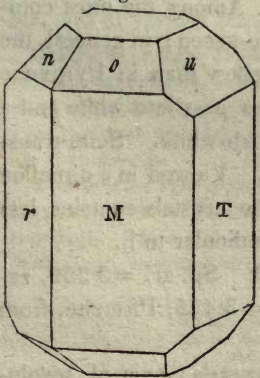
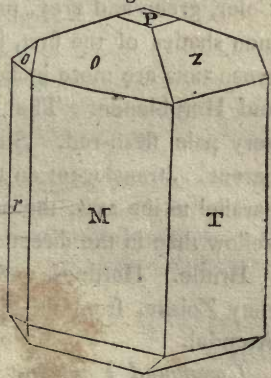


Fig. 168.

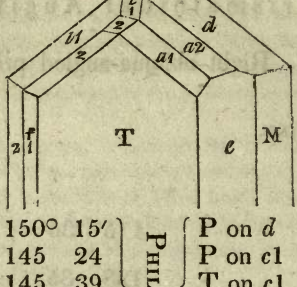


HAUY.

M on *o*	-	121°	23′
M on *r*	-	116	40
T on *u*	-	144	25
P on *o*	-	148°	37′
P on *u* (fig. 167)		125	35
P on *z*	-	145	3

Epidote.

Fig. 169.



M on *e*	-	150°	15′		P on *d*	-	145° 6′
T on *e*	-	145	24		P on *c*1	-	148 30
T on *f*1	-	145	39	PHILLIPS.	T on *c*1	-	121 50
T on *f*2	-	114	40		T on *b*1	-	104 30
M on *d*	-	125	2		T on *b*2	-	142 35

Cleavage, perfect parallel to M; less so parallel to T. Fracture, uneven. Surface, the lateral planes sometimes streaked vertically: in general, the faces are smooth.

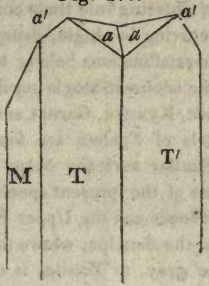
Lustre vitreous, inclining to pearly upon perfect faces of cleavage, and the corresponding faces of crystallization. Color, green and grey, prevalent. Among the most common shades of the first, is pistachio-green; in general, the green tints are more inclined to yellow than in Pyroxene and Hornblende. The grey colors pass into white and a very pale flesh-red. Streak greyish-white. Semi-transparent... translucent on the edges. Viewed in a direction parallel to the axis, the color of the crystals contains less yellow than in the directions perpendicular to it.

Brittle. Hardness $=6{\cdot}0 \ldots 7{\cdot}0$. Sp. gr. $=3{\cdot}269$, variety Zoisite, from the Saualpe; $=3{\cdot}425$, Pistazite, from Arendal.

Compound Varieties. Twin-crystals: axis of revolution parallel to the prismatic axis, as represented in the annexed figure; angle of revolution $= 180°$.

Epidote.

Fig. 170.



Franconia, (N. H.)

M on T	-	115° 36′	*a* on *a'*	-	109° 24′
T on T′	-	129 35			

Several varieties consist of concentric coats, the outer ones of which being pealed off, leave a crystal with smooth faces. Massive: composition granular, of various sizes of individuals, sometimes impalpable, strongly connected: columnar, straight, and either parallel or divergent, or irregular, and of various sizes of individuals.

1. Epidote includes *Zoisite*, or the grey and whitish colored varieties of the present species, and which by some mineralogists have been treated of, as constituting a separate species. The light reddish-black variety from Piedmont, called the Manganesian Epidote, is Zoisite tinged by oxide of manganese.

2. Before the blow-pipe, the varieties of Epidote intumesce, and partly exfoliate, but are with difficulty brought to the condition of a transparent glass. Those with much iron are more easily fused than the rest. With borax, Epidote first intumesces, and then yields a clear globule.

3. *Analysis.*

	By Klaproth, fr. the Saualpe. *Zoisite.*	By Descotils, fr. Dauphiny. *Epidote.*	By Vauquelin, fr. Norway. *Epidote.*
Silica	45·00	37·00	37·00
Alumina	29·00	27·00	21·00
Lime	21·00	14·00	15·00
Oxide of iron	3·00	17·00	24·00

4. Epidote is found variously disseminated in nearly all the primitive rocks, without however entering into their composition as a regular ingredient, but rather occurring in single, drusy cavities, narrow seams and veins. The finer crystallizations belong to beds of Magnetic Iron-Ore. The variety Zoisite occurs in single crystals and crystalline masses in beds, with Hornblende, Kyanite, Garnet and Zircon.

5. Magnificent crystals of Epidote are found in the iron-mines of Arendal, Norway. Similar varieties occur also in Sweden. Very handsome crystallizations of the present species are found in Switzerland, Piedmont, the Pyrenees and the Upper Palatinate. Less remarkable varieties come from the Saualpe, where the transition of the green colored crystals into the grey, or Zoisite, is observed. The grey colored Epidote, or Zoisite, is found in the Bache mountain and Schwamberg Alpe in Lower Stiria; in the Fichtelgebürge, and in the Tyrol. The red manganesian varieties occur at St. Marcel in the valley of Aosta in Piedmont.

Crystals, resembling in size, color and form, those from Norway and Sweden, occur in the iron-mine of Franconia and in its vicinity, in the state of New Hampshire. Very beautiful grey crystals, though of small diameter compared with their length, have been found at Hawley, penetrating small beds of quartz in hornblende-rock. The pistachio-green crystals occur at Cumberland, (R. I.) in veins and drusy cavities, in a species of trap-rock. A variety precisely similar to that from Piedmont has been found in small quantity at Haddam, (Con.) forming a vein in gneiss about one inch wide. But the greyish white colors, or Zoisite varieties, are the most frequent in the U.S. These occur in columnar compositions, in which the individuals are large, at Wardsborough, (Vt.) Milford, (Conn.) but particularly at Goshen and Williamsburg, (Mass.) In the last mentioned places they exist in veins and beds of quartz situated in mica slate. In the eastern part of Maine, a radiating variety has been discovered, which is purplish red at the centres of the fibrous masses, but assumes the pistachio-green where the fibres diverge most. A variety of Zoisite in long, nearly impalpable fibres, of a dark bluish grey color, occurs with Calcareous Spar in mica slate, at Montpelier, (Vt.)

EPISTILBITE. Diplogenous Kouphone-Spar. Mohs.

Primary form. Right rhombic prism. M on M=135° 10′.

Epistilbite.

Secondary forms.

Fig. 171.

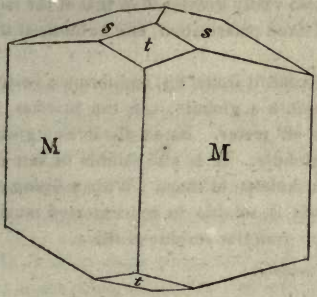
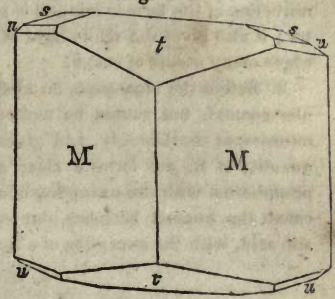


Fig. 172.



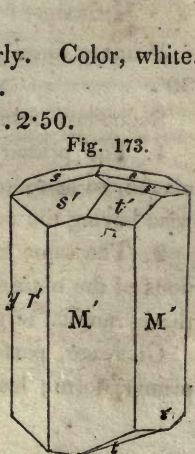
M on *t*	-	-	-	-	122°	9′
t on *t*	-	-	-	-	109	46
t on *u*	-	-	-	-	154	51
t on *s*	-	-	-	-	141	47
s on *s*	-	-	-	-	147	40

Cleavage, perfect parallel with the shorter diagonal of the prism. In other directions only an uneven fracture. Surface, the faces M shining, but uneven, not admitting of the use of the reflective goniometer; the faces *s* are dull; *t* are smooth and shining.

Lustre, on M vitreous; that of *r* pearly. Color, white. Transparent, to translucent on the edges.

Hardness = 4·5. Sp. gr. = 2·249 ... 2·50.

Fig. 173.



Compound Varieties. Twin-crystals: axis of revolution perpendicular: face of composition parallel to one of the primary lateral faces: angle of revolution = 180°. Massive: composition granular.

1. Epistilbite, according to Dr. BREWSTER, is destitute of the two systems of colored rings, which are visible in Heulandite. The double refraction of the former mineral is also vastly greater than that of the latter; it also gives the white light of fixed polarization, and exhibits at its edges many orders of colors.

2. Before the blow-pipe, on charcoal, it froths up, and forms a vesicular enamel, but cannot be melted into a globule. In the matrass, it intumesces considerably, and gives off water. Borax dissolves a great quantity of it, and forms a clear globule. It is also soluble in salt of phosphorus, with the exception of a skeleton of silica. With solution of cobalt the enamel becomes blue. It is soluble in concentrated muriatic acid, with the exception of a fine granular residue of silica.

3. *Analysis.*

By ROSE.

Silica	58·59
Alumina	17·52
Lime	7·56
Soda	1·78
Water	14·48

4. It occurs in amygdaloidal rocks in Iceland and the Faroe Islands, along with Heulandite, and at Poonah in India.

EPSOM SALT. Prismatic Epsom-Salt. JAMIESON.

Primary form. Right rhombic prism. M on M′=90° 30′.

Secondary forms.

1. The primary, having the terminal edges deeply replaced, so as to form pyramids at each extremity, and likewise having the acute lateral edges truncated.

2. The same form, with the addition of tangent truncations of the obtuse lateral edges, and of the upper edges of the pyramidal terminations.

Cleavage, perfect parallel to the shorter diagonal of the primary form; less so, parallel with the faces formed by the

truncation of the pyramidal edges. Fracture, conchoidal. Surface, crystals striated vertically upon their lateral planes.

Lustre vitreous. Color white. Streak white. Transparent . . . translucent.

Rather brittle. Hardness 2·0 . . . 2·5. Sp. gr. = 1·751. Taste saline and bitter.

Compound Varieties. Botryoidal, reniform, and in the shape of crusts: composition columnar, if the particles are very delicate, the lustre becomes pearly. Pulverulent.

1. It deliquesces before the blow-pipe, but is with difficulty fusible, if its water of crystallization has been driven off. It dissolves very readily in water.

2. *Analysis.*

By VOGEL.

Water	48·0
Sulphuric acid	33·0
Magnesia	18·0

3. It effloresces from several rocks, both in their original repositories, and in artificial walls. It forms the principal ingredient of certain mineral waters.

4. It occurs in Freiberg, and in its neighborhood, efflorescent upon gneiss; likewise in Scotland, in the Hartz, in Berchtesgaden, in Salzburg, at Idria in Carniola, in Bohemia and in Hungary.

It abounds in the limestone caves of Kentucky and Indiana, whose floors are often covered with it in delicate crystals, intermingled with dry earth to a considerable depth. In New York also, ten miles from Coeymans, on the east face of the Helderberg, it effloresces from the calcareous sandstone.

5. After having been purified, it is employed in medicine, as well as for the production of magnesia.

ERINITE. Dystome Copper-Baryte.

Highly crystalline: the individuals arranged in concentric coats, with rough surfaces, produced by the termination of exceedingly minute crystals; the layers often not

Erinite.

firmly cohering, so that they may easily be separated from one another. These layers themselves are very compact, exhibiting an uneven or imperfectly conchoidal fracture, and traces of cleavage.*

Color, a beautiful emerald green, slightly inclining to grass-green. Streak green, but paler. It is slightly translucent on the edges.

Brittle. Hardness = 4·5 ... 5·0. Sp. gr. = 4·043.

1. *Analysis.*
By TURNER.

Oxide of copper	54·44
Alumina	1·77
Arsenic acid	33·78
Water	5·01

2. It is associated with other species of arseniate of copper, and occurs in the county of Limerick in Ireland.

ERLAN.

Massive: composition granular, also impalpable and slaty. Fracture splintery and uneven.

Color greenish grey. Lustre feebly vitreous to dull. Streak white, and possessing a resinous or oily lustre.

Hardness = 5·5 ... 6·5. Sp. gr. = 3·0 ... 3·1.

1. *Analysis.*
By GMELIN.

Silica	59·8
Alumina	15·9
Lime	15·7
Oxide of manganese	5·6
Soda	3·0

2. It occurs associated with Mica at Schwarzenberg in Saxony, forming a mountain mass.

* These plates form crest-like aggregations. A circumstance which greatly increases the difficulty of observing the regular forms, is the want of lustre; the surface of the concentric layers being quite dull, while there is only a slight degree of resinous lustre on the fracture.

3. From the foregoing description, Erlan would appear to be only a variety of argillite.

ESSONITE. (See *Garnet.*)

EUCHROITE. Peritomous Copper-Baryte.

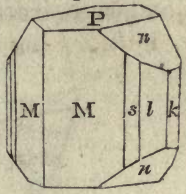
Primary form. Right rhombic prism. M on M=117° 20′.

Secondary form.

M on M	-	-	117°	20′
l on *l*	-	-	78	47
s on *s*	-	-	95	12
n on *n*	-	-	87	52

HAIDINGER.

Fig. 174.



Cleavage, parallel to the primary lateral planes, distinct; indistinct parallel to *n*.

Fracture small conchoidal, uneven. Surface, the vertical faces of the prism streaked parallel to their common edges of combination.

Lustre vitreous. Color bright emerald-green. Streak pale apple-green. Double refraction considerable. Transparent . . . translucent.

Rather brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 3·389.

1. In the matrass, it loses its water, and becomes yellowish green and friable. When heated to a certain point upon charcoal, it is reduced in an instant with a kind of deflagration, leaving a globule of malleable copper, with white metallic particles dispersed throughout its mass, which are entirely volatile upon a continued blast.

2. *Analysis.*

By TURNER.

Peroxide of copper . . .	47·85
Arsenic acid . . .	33·02
Water . . .	18·80

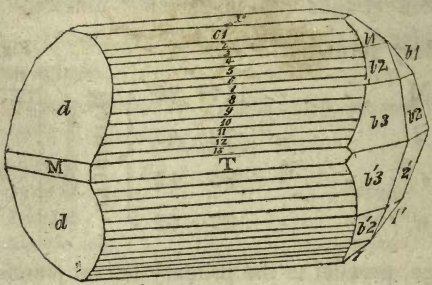
3. It was discovered at Libethen in Hungary, in quartzose mica slate.

EUCLASE. Prismatic Emerald. Mohs.

Primary form. Right oblique-angled prism. M on T = 130° 50′.

Secondary form.

Fig. 175.



Phillips.

P on M or T		90°	0′	P on *c*12	-	103°	38
M on M or T		130	52	P on *c*13	-	100	50
*b*1 on M or T		98	50	P on *b*1	-	123	10
*b*2 on M or T		100	00	P on *b*2	-	108	24
P on *c*	-	124	30	P on *b*1	-	130	10
P on *d*	-	124	24	P on *b*2	-	112	50
P on *c*1	-	122	28	P on *b*3	-	139	18
P on *c*2	-	121	30	*b*1 on *b*2	-	165	18
P on *c*3	-	120	10	*b*2 on *b*2′	-	143	32
P on *c*4	-	116	05	*b*1 on *b*2	-	162	20
P on *c*5	-	112	50	*b*2 on *b*3	-	169	45
P on *c*6	-	111	50	*b*2 on *b*1	-	143	20
P on *c*7	-	109	40	*d* on *d*	-	105	20
P on *c*8	-	108	46	*c*1 on *d*	-	140	00
P on *c*9	-	107	20	*c*1 on *b*1	-	148	10
P on *c*10	-	106	22	*c*1 on *b*1	-	115	20
P on *c*11	-	105	14				

Cleavage, highly perfect, and very easily obtained parallel to P; less distinct parallel to T. Fracture perfectly conchoidal, and very easily obtained. Surface, the face between T and P streaked parallel to their common intersection.

Lustre vitreous. Color mountain-green, passing into blue, and white, always pale. Streak white. Transparent . . . semi-transparent, generally the first.

Very brittle and fragile. Hardness = 7·5. Sp. gr. = 3·098, a greenish-white crystal.

1. Before the blow-pipe, it intumesces in a strong heat, and becomes white. If the heat be still farther increased, it melts into a white enamel.

2. *Analysis.*

By Berzelius.

Silica	43·22
Alumina	30·56
Glucina	21·78
Oxide of iron	2·22
Oxide of tin	0·70

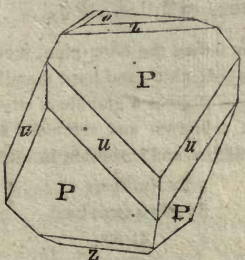
3. Nothing as yet is known with sufficient accuracy, of the mode of its occurrence in nature. The first varieties of it were brought by Dombey from Peru. It was afterwards found at Capao in the mining district of Villa-Ricca in Brazil, where it occurs in beautifully crystallized varieties in a chloritic slate, resting on sandstone, along with Topaz. It is generally brought to Europe in fractured crystals.

EUDYALITE. Rhombohedral Petaline-Spar.

Primary form. Rhomboid. P on P = 73° 40′.

Secondary form.

Fig. 176.



P on *u* - 106° 36′ | P on *z* - 126° 13′

Cleavage, parallel to *o* distinct; parallel to *z* less so: traces of cleavage parallel with the faces of the primary rhomboid. Fracture conchoidal or uneven. Surface smooth, but often rather uneven.

Lustre vitreous. Color brownish-red. Streak white. Translucent on the edges . . . opake.

Hardness = 5·0 . . . 5·5. Sp. gr. = 2·898.

1. Before the blow-pipe, it melts into a leek-green scoria. If reduced to powder, it gelatinizes with acids.

2. *Analysis.*

By STROMEYER.

Silica	52·00
Zirconia	10·89
Lime	10·14
Soda	13·92
Oxide of iron	6·85
Oxide of manganese	2·57
Muriatic acid	1·03

3. It is found in Greenland, mixed with Sodalite, Hornblende, and a mountain green variety of Feldspar.

EUKAIRITE. Selenious Polypoine-Glance

Massive: composition granular or impalpable.

Lustre metallic. Color lead-grey. Streak white, when impressed with the nail.

Ductile. Hardness = 2·0 . . . 2·5.

1. When heated alone before the blow-pipe, it emits a strong smell of selenium, and yields greyish white, and hard metallic globules. Heated with lead upon bone-ashes, it gives a globule of silver. In an open tube it affords a precipitate of selenium and selenious acid. It prevents the reaction of copper with fluxes, and is soluble in nitric acid.

2. *Analysis.*

By BERZELIUS.

Selenium	31·58		26·00
Silver	43·16		38·93
Copper	25·26		23·05
Earthy matters	0·00		8·90

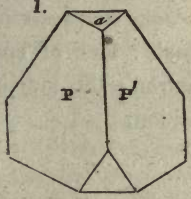
3. It occurs disseminated through Calcareous Spar, in the mine of Skrickerum in Smoland.

FAHLERZ. Tetrahedral Copper-Glance. Mohs.

Primary form. Tetrahedron.

Secondary forms.

Fig. 177.



Kapnik.

Fig. 178.

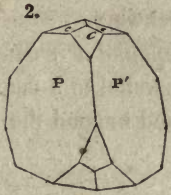
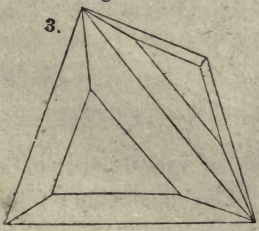
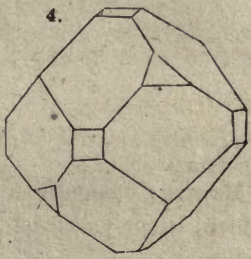


Fig. 179.



Kapnik.

Fig. 180.



Schwatz, (Tyrol.)

5. Rhombic dodecahedron.

6. Icosatetrahedron.

7. Trigonal dodecahedron, resulting from the extension of the bevelling planes in Fig. 179.

Cleavage, not visible, except traces of the octahedron. Fracture conchoidal, of different degrees of perfection Surface, the tetrahedron and the trigonal dodecahedron

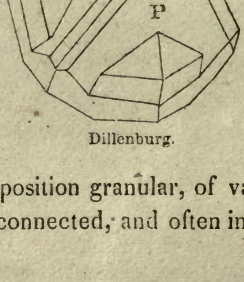
generally streaked irregularly, parallel to their common edges of combination, not rough; the dodecahedron sometimes a little rough. Some varieties are subject to tarnish.

Lustre metallic. Color steel-grey . . . iron-black. Streak unchanged, sometimes inclining to brown.

Rather brittle. Hardness = 3·0 . . . 4·0. Sp. gr. = 4·104, from Cremnitz; = 4·950 from Kapnik; = 4·798, from Schwatz.

Compound Varieties. Twin-crystals: face of composition parallel to a face of the octahedron; the individuals continued beyond the face of composition.

Fig. 181.



Dillenburg.

Massive: composition granular, of various sizes of individuals, strongly connected, and often impalpable; fracture uneven.

1. Schwarzerz has been distinguished as a subspecies under Fahlerz, but differs only in having a deeper black color, and a more conchoidal fracture.

The varieties of the present species differ somewhat in their behavior before the blow-pipe, arising chiefly, it may be concluded, from accidental mixtures, depending upon the substances with which they occur associated. Some yield arsenic when roasted, others antimony, and the residue melt in different ways. After roasting, they yield a globule of copper.

2. *Analysis.*

By KLAPROTH.

	of Fahlerz.	of Schwarzerz.
Copper	48·00	40·25
Arsenic	14·00	0·75
Antimony	0·00	23·00
Sulphur	10·00	18·50
Iron	25·50	13·50
Silver	0·50	0·30

Other varieties contain the same ingredients in other proportions. Some, moreover, contain zinc, mercury, or lead; and in some varieties as much as 13½ p. c. of silver has been discovered: in others again, a small quantity of gold is detected.

3. Fahlerz is found in beds and veins. It is accompanied by Copper Pyrites, Spathic Iron, and Quartz.

4. The varieties of a steel-grey color are found in veins near Freiberg in Saxony, and in beds in Anhalt in the county of Gömör in Hungary, in Stiria, &c.; varieties called Schwarzerz are met with in veins at Schwatz and other places in Tyrol, at Kapnik in Transylvania, at Cremnitz in Hungary; also at Clausthal and Andreasberg in the Hartz. It occurs also in the neighborhood of Dillenburg; in Mansfield; in small quantities at Airthrie, and other places in Scotland; in Cornwall, and in South America.

FAHLUNITE. Peritomous Petaline-Spar.

Primary form. Oblique rhombic prism. M on M = 109° 28′. M on P = 101° 30′. Reniform massive.

Cleavage parallel to the primary form. Fracture conchoidal . . . uneven, splintery.

Lustre vitreous. Color olive-green and oil green, passing into yellow, grey, brown, and black. Streak greyish-white. Feebly translucent on the edges . . . opake.

Hardness = 6·0 . . . 6·5. Sp. gr. = 2·61 . . . 2·66.

1. Before the blow-pipe, it becomes pale-grey, and melts on its thinnest edges. It is but slowly dissolved in glass of borax, and communicates to it the color produced by oxide of iron.

Fahlunite—Feldspar.

2. *Analysis.*

By TROLLE-WACHTMEISTER.

	A black massive var. Sp. gr. = 2·68.	Crystallized grey var. Sp. gr. = 2·74	Blackish grey var. Sp. gr. = 2·79
Silica	43·51	44·60	44·95
Alumina	25·81	30·10	30·70
Oxide of iron	6·35	3·86	7·22
Magnesia	6·57	6·75	6·04
Protoxide of manganese	0·00	0·00	1·90
do. mixed with ox. of iron	1·72	2·24	0·00
Soda	4·45	1·98	0·00
Potash	0·94		1·38
Fluoric acid with silica	0·16	0·00	0·00
Lime	0·00	1·35	0·95
Water	11·66	9·35	8·05

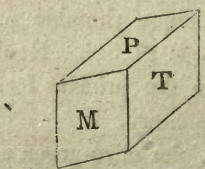
3. It occurs at Fahlun in Sweden, in a talcose or chloritic slate, with Galena and Copper Pyrites.

FASSAITE. (See *Pyroxene.*)

FELDSPAR. Orthotomous Feld-spar. MOHS.

Primary form. Doubly oblique prism.* M on T = 120°. P on M = 90°. P on T = 67° 15′.

Fig. 182.

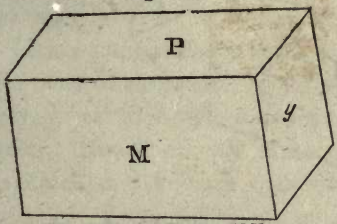


* In the description of this species, it has been found the most convenient to represent the crystals after the method of HAUY, in preference to that of BROOKE, whose projections have generally been adopted in the present work.

Feldspar.

Secondary forms.

Fig. 183.



St. Gothard.—Rossie, (N.Y.)

Fig. 184.

Fig. 185.

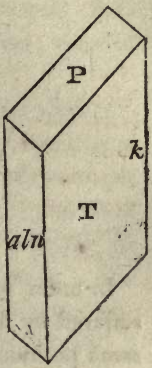
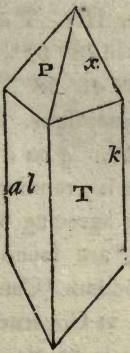
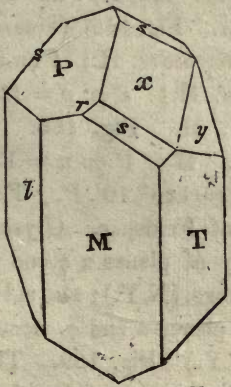


Fig. 186.



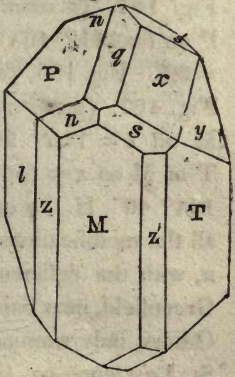
Isère.

Fig. 187.



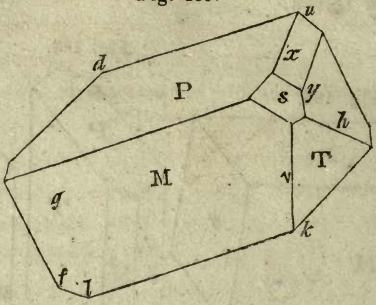
Middlefield and Becket, (Mass.)

Fig. 188.



Feldspar.

Fig. 189.



In order to render more easily intelligible the changes suffered by the primary form, the planes M and T have the same position given them in the secondary forms, as in the figure by which the primary is illustrated. Fig. 183. (*unitaire.* Hauy.) M on $y=90°$. H. P on $y=99°\ 29'$. H. Fig. 184. (*prismatique.* Hauy.) M on $l=120°$. H. P on $l=111°\ 40'$. H. Fig. 185. (*binaire.* H.) T on $l=60$. Fig. 186. (*ditetràedre.* H.) P on $x=128°\ 51'$. H. Fig. 187. (*sexdécimal.* H.) x on $y=150°\ 45'\ 28''$. H. M on $s=116°\ 20'$. H. Fig. 188. (*synoptique.* H.) T or M on $z=150°$. M or P on $n=135°$. q on $x=164°\ 40'$. H. q on $s=149°\ 10'$. P. This is a reunion of all the modifications of Feldspar. Crystals agreeing with it, with the deficiency of planes n q and y, are found at Greenfield, near Saratoga, (N.Y.); also at Haddam, (Conn.) Others, only wanting planes n and q, occur at Governeur, St. Lawrence co. (N.Y.) Fig. 189. This is an elongation of Fig. 187, in the direction of the edge between P and M. Fig. 188, suffers the same elongation in the direction of the plane n.

Feldspar.

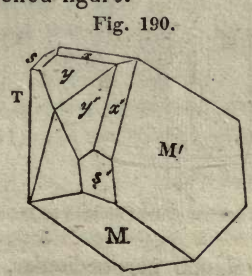
Cleavage, parallel with P highly perfect, and easily obtained; parallel with M perfect, with T obscure, though sometimes obvious. Fracture conchoidal to uneven. Surface frequently streaked in a horizontal direction; most of the other faces are smooth.

Lustre vitreous, sometimes inclining to pearly upon perfect faces of cleavage. Color white, prevalent, inclining to grey, green and red; sometimes grey, flesh-red, verdigris green. Streak greyish white. Transparent, translucent on the edge. A bluish opalescence observable in the direction of T, most distinctly in transparent varieties. The variety called moonstone, from Ceylon, appears considerably more red, and of a lower degree of transparency, if viewed perpendicularly to T, than in any other direction.

Brittle. Hardness = 6·0. Sp. gr. = 2·558, a white transparent variety; limits of the species 2.53 . . . 2·60.

Compound Varieties. Twin-crystals. 1. Face of composition parallel with the edge between P and M. (Fig. 189.) Axis of revolution perpendicular to the plane *d g f l k h u* of the same figure. Angle of revolution = 180°. See annexed figure.

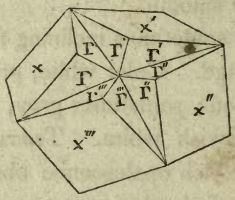
Fig. 190.



If this mode of composition be repeated on all the faces of the same form, four sided prisms, consisting of four indi-

viduals, will be formed, which are nearly rectangular, and bounded on their extremities by the faces P P and x x. This composition is seen in the annexed figure.

Fig. 191.



It is a frequent form, from St. Gothard.

2. Two crystals, like Fig. 187, excepting planes x and s. Axis of revolution parallel to the principal axis, face of composition parallel either to the right (Fig. 192.) or to the left faces (Fig. 193.) of M.

Fig. 192.

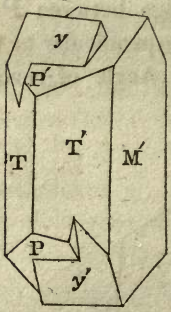
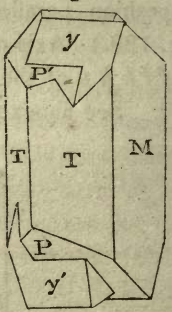


Fig. 193.

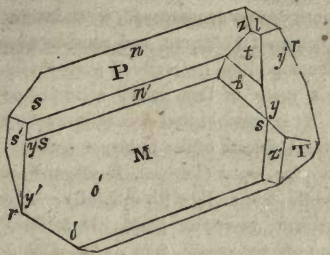


Both are found near Elbogen in Bohemia.

3. Axes of revolution perpendicular, face of composition parallel to P, angle of revolution $=180°$.

Feldspar.

Fig. 194.



La Clayette and Loire in France.

Sometimes there occurs a composition according to several of these laws at once. Massive: composition granular, of various sizes of individuals, sometimes lamellar.

1. Several distinct species were formerly included under the name of Feldspar, and variously subdivided into subspecies and varieties. First, those gray varieties which possess bright iridescent colors, were established into a particular subspecies, under the name of *Labrador Feldspar*. These are now known to comprehend varieties of Feldspar and of Labradorite. The most transparent and pure varieties, generally in implanted crystals, lining the walls of narrow veins in ancient rocks, were likewise considered as a particular subspecies, and called *Adularia*. It is made up of Feldspar and Albite. The less transparent varieties were divided into *common* and *compact Feldspar;* the first of which contained, though not exclusively, easily cleavable crystals; the second, imbedded crystals, having no distinct cleavage, and compound masses of small, or impalpable and strongly connected individuals. *Common Feldspar* contains varieties of all the species enumerated above. From it, *Clinkstone*, which is commonly a mixed mineral, and forms the mass of porphyry-slate, was distinguished as a particular species; so also was *Variolite*, consisting of small globular masses, imbedded in a mixed rock. It has not been exactly ascertained to what species Clinkstone and Variolite belong. Imbedded crystals of considerable degrees of transparency, in porphyry slate, occurring also in various other trachytic and volcanic rocks, were called *glassy Feldspar*. *Ice-spar* occurs in white transparent crystals, greatly resembling Adularia and glassy Feldspar, but implanted in the drusy cavities of rocks ejected by Mount Vesuvius. In regard to

the particular state, in which the varieties of common Feldspar occur, those which are more or less decomposed, were designated by the denomination of *earthy common Feldspar*, and considered as a particular subspecies. If the decomposition has arrived at its limits, so that the whole is converted into a more or less firmly coherent powder, *Porcelain-Earth* is formed. It is possible that porcelain-earth arises from the decomposition of several species of the Feldspar family.

Before the blow-pipe, upon charcoal, Feldspar becomes glassy, semi-transparent and white, but melts with difficulty, and only upon its edges, into a semi-transparent, vesicular glass. It is dissolved by borax, but slowly and without effervescence, into a clear globule. It is not acted upon by acids.

Analysis.

	By Vauquelin.	By Klaproth.
	Adularia.	Common Feldspar fr. Carlsbad.
Silica	64·00	64·50
Alumina	20·00	19·75
Potash	14·00	11·50
Lime	2·00	a trace.
Oxide of iron	0·00	1·75
Water	0·00	0·75

Feldspar frequently enters into the composition of rocks, and constitutes, with Quartz and Mica, the different kinds of granite and gneiss; with Hornblende, it forms syenite and greenstone; and with Augite, the Augite-rock. To several of these rocks, large crystals of Feldspar impart a porphyritic appearance; and it is a characteristic mark of the different kinds of porphyry more properly so called, to have isolated crystals of this species distributed throughout their compact mass. Basalt, and some other allied rocks, must be considered as most intimate mixtures of Feldspar with Hornblende or Pyroxene, or with both these species, the individuals being so small as to be no longer recognizable. In several of these rocks which contain Feldspar as one of their ingredients, larger masses of it frequently form concretions separated from the rest, and assume the shape of more or less extended beds. If these be decomposed by the action of the atmosphere, and their situations be favorable, Porcelain earth is formed, among the most remarkable of which we notice those in gneiss, at Aue near Schneeberg in Saxony, and at Hafnerzell in the district of Passau. At Carclaise and Cligga in Cornwall, the porcelain earth originates in the decomposition of granitic rocks. It occurs frequently in beds along with ores of iron and titanium, with sev-

eral species of the Hornblende and Garnet families; but it may be considered as a rarity in veins, except in those which are composed of the same species of which the rocks consist which they traverse. In these, its varieties are accompanied by Axinite, Quartz, several ores of titanium, Calcarious Spar and other species; and have their surface sometimes covered with scaly particles of Talc. Sometimes the crystals have their surfaces, particularly the planes M, covered with crystals of Albite, disposed in parallel position.

The finest crystals of Adularia are found in the highest districts of St. Gothard, and the Alps of Savoy; several varieties occur also in Salzburg, the Tyrol, Bavaria, Dauphiny, the isle of Arran, in Cornwall and Wales. Very large crystals of Feldspar are found in Siberia, which are generally penetrated by Quartz, sometimes of considerable transparency. Amazon stone, a verdigris-green variety, associated with small white crystals of Albite, occurs near Fort Troitzk in the Uralian mountains. Compact Feldspar, forming the body of clinkstone-porphyry, is found in the Bohemian Mittelgebirge, in the western isles of Scotland, at Sahla in Sweden, in the Hartz, &c. Variolite has been noticed from Piedmont and Corsica. The finest varieties of porcelain earth are those from China, where it is called Kaolin, from Saxony, from Passau, and from Limoges in France.

The United States have thus far afforded few handsomely crystallized specimens of the present species, although they have been quoted from a number of localities. The most interesting of these are Rossie and Governeur in St. Lawrence co. (N.Y.) Greenfield near Saratoga in the same state, and Haddam, (Conn.) At the first mentioned place it is associated with crystallized, white Hornblende and Scapolite in limestone, and at the two last with Chrysoberyl, Garnet and Tourmaline in a granitic vein. A few crystals have been afforded, apparently belonging to this species, at Franconia, (N.H.) in a vein made up chiefly of large crystals of Epidote and Quartz. Crystallized Feldspar in small quantity, frequently accompanies Beryl in N. England; and is met with also in loose masses, lining small cavities in a rock made up of Hornblende, Augite, and massive Feldspar. The crystals are often deeply imbedded in Calcareous Spar. Under these circumstances, it has been found at Middlefield and Becket, (Mass.) Feldspar exists in very large imperfect crystals, disseminated through gneiss, and imparting to it a porphyritic appearance, throughout the primitive region of New England. It is found of a verdigris green color, crystallized and massive, at Beverly, (Mass.) The flesh-colored varieties appear to abound more in the

granite which accompanies the Atlantic coast from Connecticut to Maine, though often met with in the interior. Adularia, or opalescent varieties, though not the most strongly marked, occur in Worcester co. (Mass.) and in the granite bordering upon Lake George, near Ticonderoga, (N.Y.) as well as at Haddam, (Conn.) and Paris in Maine. Feldspar in very large, perfectly cleavable individuals, and suited to all the purposes of porcelain manufacture, abound in Charles co. (Penn.,) Delaware, in the Highlands of New York, and at several places in N. England, too numerous to be mentioned. Decomposed Feldspar is met with occasionally in granite beds, as at Andover, (Mass.); in Cheshire, (Conn.) a deposit was discovered in digging the Farmington Canal, which appears to have owed its origin to the red sandstone formation.

Several varieties of this species are used in the arts and manufactures. The purest opalescent varieties of Adularia are cut round and polished, and worn as ring stones, &c. The finest of them are from Ceylon, and are called *moon-stones*. The *sun-stone* is also used in jewellery: it exhibits, reddish and variegated patches of light, in the shape of oblique-angled parallelograms on the cleavage face T. This variety is found at Lyme, (Connecticut.) *Graphic granite* is cut for snuff-boxes, &c.: it consists of a simple variety of the present species, regularly mixed with long parallel crystals of Quartz, whose transverse angular sections bear some resemblance to certain letters. The pure varieties of Feldspar are used in the composition of the paste of porcelain, also for the enamel with which it is covered; and the decomposed variety, or porcelain earth itself, is the most important material in that department of manufactures.

Appendix to Feldspar.

i. *Mikroclinous Felsite.* Breithaupt.

P on M = 112° 15′. P on T = 90° 21′. M on T = 118° 35′.
Cleavages very perfect.
Hardness = 7·75 . . . 8·0. (scale of Breithaupt.)
Sp. gr. = 2·562, reddish to liver-brown, from Arendal.
2·565, reddish white, from Arendal.
2·567, grey, with blue opalescence, from Friedrichsvairn.
2·568, do. in small pure cleavage forms.

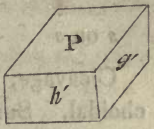
The composition of Mikroclinous Felsite is, according to KLAPROTH,

Silica	65·00
Alumina	20·00
Potash	12·25
Oxide of iron	1·25
Magnesia	a trace.
Water	0·50
	99·00

ii. *Murchisonite.* LEVY.

Fig. 195.

P on g'	90° 00′
g on h'	90 00



The two cleavages which are at right angles, are like Feldspar; the third has a nacreous lustre, and is as easily obtained as the others. The plane P of this figure is not afforded by cleavage in common Feldspar.

Color white, with a tinge of red. Opake.

It occurs at Heavitree near Exeter, forming a compact rock, associated with Quartz, Mica and black Tourmaline; and is connected with the red marl.

iii. *Ryakolite.* ROSE?

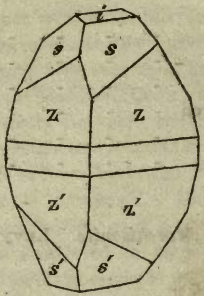
The experiments of G. ROSE upon the glassy Feldspar, are said to have rendered it apparent that its angles are different from those of Feldspar, and from the above enumerated varieties, proposed as species. Its sp. gr. = 2·576. It occurs in the lava of Vesuvius, and in that of the Lacher Lake.

FERGUSONITE.

Primary form. Right square prism.

Fergusonite.

Secondary form. Fig. 196.



s on s - 100° 30′ | z on z' - 159°

Cleavage, traces parallel to s. Fracture perfectly conchoidal. Surface rather uneven.

Lustre imperfectly metallic, inclining to resinous. Color dark brownish black; in thin splinters, pale. Streak very pale brown, like Rutile. Opake; in thin splinters, translucent.

Brittle. Hardness = 5·5 . . . 6·0. Sp. gr. = 5·838.

1. Before the blow-pipe, it loses its color and becomes pale greenish-yellow, but alone, is infusible. It is entirely dissolved in salt of phosphorus, but some particles remain a long time unaltered. The pale greenish globule becomes opake by flaming, or on cooling, when very much saturated. Before the whole portion has been dissolved, it assumes a pale rose color in the reducing flame.

2. *Analysis.*

By HARTWALL.

Columbic acid - - -	47·75
Yttria - - -	41·91
Oxide of Cerium - - -	4·68
Zirconia - - -	3·02
Oxide of tin - - -	1·00
Oxide of uranium - - -	0·95
Oxide of iron - - -	0·34

3. It is found imbedded in Quartz at Kikertaursak, near Cape Farewell in Greenland.

FERRUGINOUS PLATINA.

In crystals and grains. The form of the crystals described as cubical.

Color dark platina-grey. Surface tarnished, like meteoric iron. Hardness = 8·0 ... 8·5. (Scale of BREITHAUPT.)

Malleable. Sp. gr. = 14·6 ... 15·7. It is magnetic; and in some cases not only attracts, but repels the needle.

1. It gives, by chemical trials, evidence of a considerable portion of iron.

2. It is found in the platina sand from Nijnotaguilsk in the government of Perme in Siberia.

3. Whether it be specifically distinct from Native Platina, still admits of a doubt.

FETTBOLE.

Massive; composition impalpable. Fracture conchoidal. Color liver-brown. Lustre resinous. Opake. Hardness = 1·50 ... 2·0. Sp. gr. = 2·249. It falls to pieces in water, attended with a crackling noise. According to KERSTEN, it consists of a tri-silicate of iron, with 9 proportionals of water. It is, without doubt, an accidental mixture of these principles, resulting from the decomposition of some one or more mineral species.

FETTSTEIN. (See *Nepheline.*)

FIBROLITE. (See *Kyanite.*)

FIGURE-STONE. Glyptic Atelene-Picrosmine.

Massive: composition impalpable. Fracture coarse splintery, imperfectly slaty.

Color white, grey, green, yellow, red and brown; none of them bright. Acquires some lustre in the streak. Translucent, in most cases, only on the edges.

Hardness = 2·0 ... 2·5. Sp. gr. = 2.815 ... 2·9.

1. Before the blow-pipe, it is infusible, but becomes white. It is partly soluble in sulphuric acid, leaving a siliceous residue.

2. *Analysis.*

	By KLAPROTH.	By THOMSON.
Silica	54·50	49·816
Alumina	34·00	20·596
Potash	6·25	6·800
Lime	0·00	6·000
Oxide of iron	0·75	1·500
Water	4·00	5·000

3. It is brought from China. Less characteristic varieties have been found also in Transylvania and in Saxony.

4. It is cut by the Chinese into various ornaments and grotesque shapes.

FIORITE. (See *Opal.*)

FLINT. (See *Quartz.*)

FLUCERINE. Rhombohedral Tungstic-Baryte.

Primary form. Rhomboid, of unknown dimensions.

Six-sided prisms, plates and amorphous masses.

Cleavage most distinct perpendicular to the axis, or parallel with the base of the hexagonal prism.

Fracture uneven and splintery.

Color reddish white to yellow. Streak white to yellow. Opake or translucent on the edges.

Hardness = 5·50 ... 5·75. Sp. gr. = 4·7.

1. Heated in the matrass, or the glass-tube, it corrodes the glass. Alone, it does not fuse, but its color changes to brown; with borax and salt of phosphorus, it gives a red or orange colored globule, which becomes pale on cooling.

2. *Analysis.*

	By BERZELIUS.
Fluoric acid	16·24
Peroxide of cerium	82·64
Yttria	1·12

3. It occurs at Finbo and Brodbo, near Fahlun, imbedded in Albite and Quartz.

APPENDIX TO FLUCERINE.

i. *Fluate with excess of base.*

Traces of crystalline structure. Color yellow.

It resembles porcelain jasper. Before the blow-pipe, it scarcely differs from the foregoing description. If heated alone on charcoal, it turns black, at an incipient redness; but assumes on cooling, successively, dark brown, red and orange tints. It is composed, according to BERZELIUS, of

Fluoric acid - - -	10·85
Peroxide of cerium - - -	84·20
Water - - -	4·95

It is found at Finbo.

ii. *Fluate of Yttria and Cerium.*

Earthy; found in masses seldom exceeding the size of a pea. Color pale red, sometimes deep red, yellow or white. Easily scratched by the nail.

According to BERZELIUS, it is a mechanical mixture of fluate of yttria with fluate of cerium and silica. It gives nearly the same reactions as the neutral fluate, first described.

FLUELLITE. ——— Fluor Haloide?

Octahedron with a rhombic base. P on P′=144°. P on P″ over the summit =109°.

Color white. Transparent.

1. It occurs in minute crystals of the form above mentioned, having its most acute solid angles replaced, along with the Wavellite from Cornwall. It has been found to contain alumina and fluoric acid.

2. Its hardness and specific gravity require to be known, before its place in the natural system can be correctly determined.

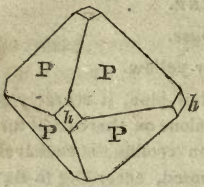
FLUOR. Octahedral Fluor-Haloide. MOHS.

Primary form. Regular octahedron.

Fluor.

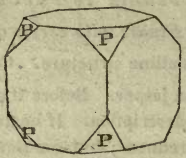
Secondary forms.

1. Fig. 197.



St. Gallen, Stiria.

2. Fig. 198.

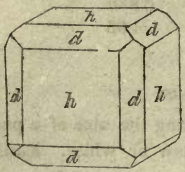


St. Gallen.

3. Cube.

The most common form.

4. Fig. 199.

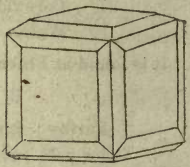


Derbyshire.
Trumbull, (Conn.)

5. Rhombic dodecahedron.

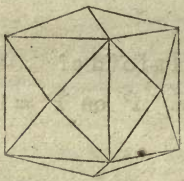
Ehrenfriedersdorf, Sax.

6. Fig. 200.



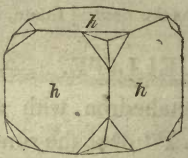
Derbyshire.
Trumbull, (Conn.)

7. Fig. 201.



St. Agnes, Cornwall.

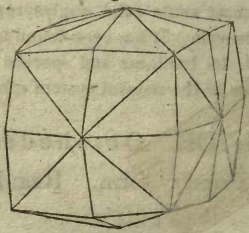
8. Fig. 202.



Zinnwald, Saxony.

9. Fig. 203.

10. Fig. 204.



Fluor.

In addition to the foregoing, are found crystals in the form of a cube, with its edges replaced by three planes, and also having the additional planes of Fig. 202. PHILLIPS describes a crystal in his possession, whose general form is that of a cube, but whose edges are replaced by seven planes, and whose solid angles are replaced by more than four times this number, and resulting in a form bounded by 322 planes.

Cleavage, parallel with the faces of the regular octahedron perfect: rarely also, parallel with the faces of the rhombic dodecahedron and cube. Fracture conchoidal, more or less perfect.

Surface. The cube generally smooth. Octahedron often rough and drusy. Dodecahedron various, being sometimes smooth, at other times rough and drusy. Sometimes the faces of the cube and the tetraconta-octahedrons are curved.

Lustre vitreous.

Color white, though not very common, and seldom pure. Generally wine-yellow or violet-blue. Among its brightest colors are emerald and pistachio-green, sky-blue, rose-red, and crimson-red. The dark blue colors bordering upon black, are probably due to bituminous impregnations. Frequently different shades of colors are disposed in coats parallel to the faces of the cube, or symmetrically distributed along the edges or solid angles of crystals.

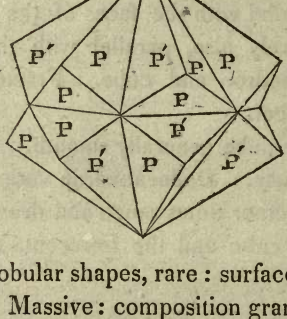
Streak white. It is sometimes slightly tinged, if the colors be very deep.

Translucent . . . transparent. Sometimes different colors appear by reflected and by transmitted light.

Brittle. Hardness $=4{\cdot}0$. Sp. gr. $=3{\cdot}140$.

Compound Varieties. Twin-crystals. Face of composition parallel to one of the faces of the octahedron; the individuals having one of their axes parallel, are continued beyond the face of composition, and particles of the one are observed formed upon the faces of the other. See annexed figure.

Fig. 205.



Implanted globular shapes, rare: surface drusy, composition columnar. Massive: composition granular, the individuals being of various sizes; if the composition be impalpable, its fracture becomes flat conchoidal and splintery, the surface of fracture being scarcely glimmering. Massive varieties are also sometimes composed of columnar particles, generally of considerable size, seldom thin or diverging, but very often forming a second curved lamellar composition. The faces of composition are sometimes irregularly streaked, more generally uneven and rough.

1. Before the blow-pipe, it decrepitates, and becomes phosphorescent, but loses its color and melts at last into a rather opake globule. It phosphoresces likewise, if thrown upon ignited charcoal or heated iron. Several varieties which exhibit this property in particularly bright green colors, have been called *Chlorophane* or *Pyro-smaragdus*. If exposed to a high degree of temperature, they lose the property of again

showing this phenomenon. Sulphuric acid decomposes the powder of the mineral, attended with the evolution of fluoric acid, which is recognized by its property of corroding glass. Several varieties, particularly the sky-blue ones, lose their color on being exposed to the light.

2. *Analysis.*

By KLAPROTH.

Lime - - - -	67·75
Fluoric acid - - - -	32·25

3. Fluor does not enter as a regular constituent into the composition of rocks. It is not very frequently found in beds. More generally it occurs in veins, with other minerals, in primitive or transition rocks. Very seldom it is associated with petrifactions, as the blue varieties of Derbyshire, with entrochites.

4. The most beautiful crystals of Fluor are found at Beeralston in Derbyshire, at St. Agnes and other places in Cornwall, and at Zinnwald in Bohemia. Large crystals, generally twins, of the cube, of handsome blue and green colors, occur at Alston in Cumberland, which frequently contain water. Beautiful, dark blue, perfect crystals, having their edges and angles highly replaced, have been found along with Quartz in porphyritic greenstone, near Gourock in Renfrewshire. Well defined crystals of the primary form, of an apple green color, occur at Moldavia in the Bannat of Temeswar. Rose red octahedrons, occasionally of great magnitude, are met with near Chamouni in Savoy. The Saxon varieties are generally of a cubical form, and of violet blue, or wine yellow, colors. The compound uncleavable varieties (*compact fluor*) are chiefly from Strassberg and Stollberg in the Hartz, from Cornwall and Sweden. The friable ones, (*earthy fluor*,) are found in Saxony, England and Norway. The chlorophane occurs at the Pednandrae mine in Cornwall, and at Ecatherineburg in Russia. Specimens from the latter place have been observed to phosphoresce simply from the warmth of the hand.

The United States have not proved very productive in handsome varieties of Fluor. The most remarkable region in this country for the present species, is situated in the State of Illinois, along the country south-west from Cave rock on the Ohio for thirty miles, in Gallatin co. It exists in nodular masses, disseminated through the soil, or occurs imbedded in a compact limestone. Its crystals are often large, and present a diversity of colors; the prevailing one, however, is a dark purple, almost black, but appearing extremely rich by transmitted light. The darker colored varieties emit a bituminous odor when cleaved. Green octahedrons, sometimes an inch in diameter, have been found imbedded

in a crystalline Quartz in the notch of the White Mountains in New Hampshire. Fluor (variety *Clorophane*) of several colors accompanies the Topaz and Magnetic Iron-Pyrites, at Trumbull, (Conn.) where it also forms entire veins in gneiss. An emerald green, massive variety occurs in narrow seams in mica slate, at Putney in Vermont. Other American localities are the following: Smith co. (Tennessee) in white and purple cubes; in Virginia, near Woodstock, Shenandoah co., in small loose masses, in the fissures of a limestone rock containing shells; also at Shepherdstown on the Potomac, in veins of white limestone, of red and purple colors; in New Jersey, near Franklin furnace; in New York, at Amity, in thin seams in white limestone, along with yellow Tourmaline, Hornblende and Spinel; and at Lockport and its vicinity, in white cubes, in black limestone, associated with crystallized Calcareous Spar and Celestine; in Massachusetts, at the Southampton lead-mine.

Forsterite.

Primary form. Right rhombic prism? M on M = 128° 54′.

Secondary form. The primary, having its terminal, and its acute lateral, edges replaced by single planes: the inclination of the faces on the terminal edges to the base = 126° 6′.

Cleavage, parallel with P.

Color white. Translucent.

1. It is inferred from the experiments of Children, to be a silicate of magnesia.

2. It is found with Spinel and Pyroxene on Mount Vesuvius.

FRANKLINITE. Dodecahedral Iron-Ore. Mohs.

Primary form. Regular octahedron.

Secondary form. Regular octahedron, with its edges truncated. Irregular forms, grains.

Cleavage parallel with the primary form, but not perfect. Fracture conchoidal. Surface of all the faces smooth.

Lustre metallic. Color iron-black. Streak dark brown. Opake.

Brittle. Acts upon the magnetic needle, but does not exhibit magnetic poles. Hardness $=6{\cdot}0 \ldots 6{\cdot}5$. Sp. gr. $=5{\cdot}091$.

Compound Varieties. Massive: composition granular, strongly connected.

1. Before the blow-pipe, alone on charcoal, it presents the appearances of Magnetic Iron-Ore; but with soda in a good reduction fire, it emits the white smoke of Zinc, and becomes green when heated with the same reagent upon platina-foil in the oxidation-heat of the instrument.

2. *Analysis.*

	By Berthier.	By Thomson.
Peroxide of iron	66·00	66·10
Red oxide of manganese	16·00	0·00
Oxide of zinc	17·00	17·425
Deutoxide of manganese	0·00	14·96
Silica	0·00	0·204
Water	0·00	0·560

3. Franklinite is found at Franklin furnace in Hamburg, (N. Jersey,) accompanied by Red Zinc-Ore, Calcareous Spar and Garnet. The most perfect crystals at this locality are imbedded in the Red Zinc-Ore; those engaged in the Calcareous Spar, and associated with Garnet, exhibit rounded faces, resulting from the truncation of the solid angles of the primary form. A more remarkable deposit of the present species occurs at Stirling in the same region, where it exists in a powerful vein, in which, cavities occasionally appear containing crystals of a very large size, from one to three inches in diameter, and which are associated with Troostite.

Gabbronite. (See *Scapolite*.)

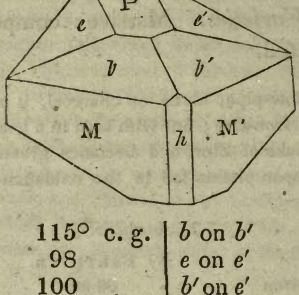
GADOLINITE. Hemi-prismatic Melane-Ore. Partsch.

Primary form. Oblique rhombic prism. M on M $=$ 115°.

Gadolinite.

Secondary form.*

Fig. 207.



M on M′	-	115° c. g.	*b* on *b*′	-	120°
P on *h*	-	98	*e* on *e*′	-	120
M on *e*	-	100	*b*′ on *e*′	-	130
M on *b*	-	153			

Cleavage, so imperfect, that its direction has not been ascertained. Fracture conchoidal.

Lustre vitreous, inclining to resinous. Color greenish-black, very dark. Streak greenish-grey. Translucent on the edges, almost opake.

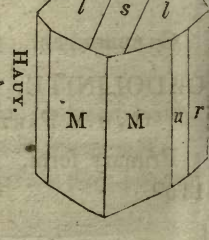
Hardness = 6·5 . . . 7·0. Sp. gr. = 4·0 . . . 4·3.

---

* The Abbé Hauy gives the following figure and measurements for this substance, which, however, are only claimed to be approximations

Fig. 206.

M on *l*	-	143°	12′
M on *r*	-	125	16
M on *u*	-	160	32
l on *l*	-	142	8
l on *r*	-	108	50
l on *s*	-	161	11
r on *s*	-	90	00
r on *u*	-	144	44



HAUY.

Compound Varieties. Massive: composition impalpable. Fracture conchoidal.

1. As soon as the heat of the blow-pipe is communicated to thin fragments, they exhibit an instantaneous glow. In the strongest heat the mass swells up, turns greyish green, and is traversed by numerous fissures. In very thin fragments, it melts with difficulty, into a greyish glass. Some varieties, according to BERZELIUS, become white, and swell into cauliflower-like masses, without suffering fusion; while others, according to PHILLIPS, fuse readily, after some decrepitation, into a black glass.

2. *Analysis.*

	By BERZELIUS.		
	fr. Finbo.	fr. Brodbo.	fr. Korarfvet.
Yttria - -	45·00	45·95	47·62
Protoxide of iron	11·43	12·63	8·30
Protoxide of cerium	17·92	18·20	3·40
Silica - -	25·80	24·16	29·20
Lime - -	0·00	0·00	3·47
Oxide of manganese	0·00	0·00	1·42
Glucina - -	0·00	0·00	1·70
Water - -	0·00	0·00	5·20

3. Gadolinite occurs in gneiss and granite, and is chiefly accompanied by Feldspar, Albite and Quartz. Its localities are Ytterby near Stockholm, and Finbo and Brodbo near Fahlun in Sweden. It is also found in Greenland.

GAHNITE. (See *Automalite.*)

GALACTITE.

A name which has been given to a mineral found in the trap of Kilpatrick, near Glasgow; but which is probably a variety of Analcime.

GALAPEKTITE. (See *Halloysite.*)

GALENA. Hexahedral Polypoione-Glance.

Primary form. Cube.

Secondary forms.

1. Cube, with the angles truncated.

2. Regular octahedron. Bleiberg in Carinthia. Southampton, (Mass.)

3. Octahedron, with its angles truncated. Cumberland, England.

4. Octahedron, with its angles replaced by four planes resting on the octahedral planes.

5. The same, with the truncation of the summits of the four-sided pyramids situated upon the angles of the octahedron.

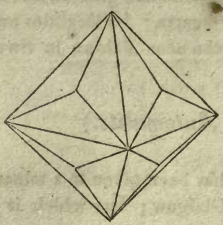
6. The octahedron, with the edges truncated.

7. The octahedron, with the edges bevelled, and the angles truncated,—the truncating planes being the primary faces of the species.

8. The same, excepting that the edges are replaced by three planes, (*pentacontaëdre*, HAUY,) from Feistriz in Stiria.

9. The trigonal icositetrahedron.

Fig. 208.



Cleavage, parallel with the cube, highly perfect, and easily obtained. Fracture rarely discoverable. Surface, the cube and the trigonal-icositetrahedron streaked parallel to the edges of combination with the octahedron. Sometimes subject to tarnish.

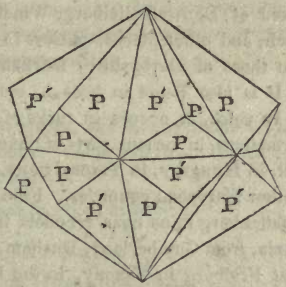
Lustre metallic. Color pure lead-grey. Streak unchanged.

Galena.

Rather sectile. Hardness = 2·5. Sp. gr. = 7·568, of a cleavable variety.

Compound Varieties. Twin-crystals; face of composition parallel, axis of revolution perpendicular to a face of the octahedron.

Fig. 209.



Kapnik, Transylvania.

Reticulated, tabular, and some other imitative shapes, the individuals of which are often still observable. Massive: composition granular, of various sizes of individuals, sometimes impalpable. In this case the color becomes pale, or whitish lead-grey, the fracture even, or flat conchoidal, and the streak shining. The granular particles of composition sometimes become elongated, or compressed in one direction, and then approach to lamellar or columnar ones. Pseudomorphoses of Pyromorphite. Plates, &c.

1. Before the blow-pipe, it melts, if heated with precaution, and yields after the sulphur has been driven off, globules of metallic lead. It is partly soluble in nitric acid, and leaves a white residue.

2. *Analysis.*

By Thomson.

Lead	85·13
Sulphur	13·02
Iron	0·50

Galena.

3. Galena is frequently found in veins, but also in great quantity in beds, particularly in limestone rocks. In beds, it is accompanied by various other ores of lead, by Blende, Copper and Iron-Pyrites; in veins, it occurs along with ores of silver, copper and antimony, sometimes with Native Gold. In both cases it is attended by Fluor, Calcareous Spar and Quartz.

4. The remarkable beds of Galena in Carinthia, which occur in limestone, and are worked at Deutsch-Bleiberg, Windisch-Bleiberg, Windisch Kappel, Ebriach, and other places, possess in several respects a striking similarity to those of Derbyshire, Durham and Northumberland, in England. It is also found in beds in older rocks, as in Stiria, Carinthia, &c. In veins, it occurs in rocks of different ages, from gneiss to the coal formations, in various parts of Saxony and Bohemia, in the Hartz, in Anhalt, in Hungary, in Transylvania, in France, in Scotland, and in many other European countries. Fine crystals have been obtained from the Pfaffenberg mine near Neudorf in Anhalt, from Saxony, from Transylvania, from Cumberland, Durham, &c. Compact Galena chiefly occurs at Freiberg in Saxony, in the Hartz, in Carinthia, and at the Lead Hills in Scotland. The *Specular Galena*, or *Slickensides*, which consists of an extremely thin coating of this species on Quartz, or on some other mineral, is found principally in some of the mines of Derbyshire.*

American localities of Galena are exceedingly numerous, although we have but few valuable mining deposits of this species. The most important are those situated in Missouri, in the counties of Washington, St. Genevieve, Jefferson and Madison; and at Galena in the north-west part of the State of Illinois. In these regions the Galena is found in an alluvial deposit of clay and marl, through which are disseminated masses of Quartz,—the whole resting upon a secondary limestone. Numerous localities might also be quoted in Kentucky, Ohio, Tennessee, Virginia and Maryland. In Pennsylvania, it occurs on Perkiomen creek, 23 miles from Philadelphia, accompanied by several of the salts of lead; and in New York at Ancram, and in Livingston's manor in Columbia co. In Connecticut, besides thin veins at Middletown, Huntington, and South-

* The Quartz or mineral on which it is formed, constitutes the vein stone, adhering to both walls of the vein; when these vein stones meet, each being thinly coated by Galena, they are readily separated by the pick, and indeed sometimes fly off spontaneously, with a loud explosion.

ington, a deposit has lately been discovered at Brookfield, whose extent is not yet fully developed. In Massachusetts, numerous veins have been discovered in Hampshire county, the most important of which exist at Southampton and Northampton. In addition to the foregoing, it may be added that Galena has been found in Vermont and Maine.

Galena is the source of the principal part of the lead of commerce. On account of its generally containing a small quantity of silver, it is also employed to a considerable extent for the extraction of this metal. Potters use either the Galena reduced to powder, or the litharge produced from it, for glazing coarse pottery.

GANOMATITE.

Massive: in crusts, and kidney-shaped. Fracture conchoidal. Lustre vitreous. Color yellow, to brown and green. Sp. gr. = 2·926.

Other properties and locality, unknown.

GARNET. Dodecahedral Garnet. MOHS.

Primary form. Rhombic dodecahedron.

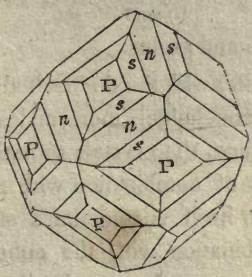
Secondary forms.

1. Dodecahedron, with the edges truncated. Hamburg, (N. J.)

2. Trapezohedron. Washington, (Conn.) Common.

3. Dodecahedron, with the edges replaced by three planes, (*trié marginé*. HAUY.)

Fig. 210.

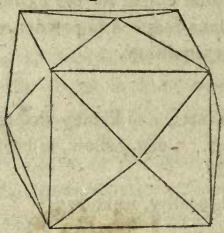


Franconia, (N. H.)

4. The same as 1. with the addition of the truncation of the acute solid angles of the dodecahedron by four planes resting upon the edges of the dodecahedron, (*uniternaire.* HAUY.) Bannat of Temeswar.

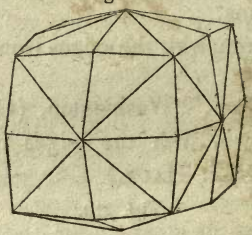
5. Icositetrahedron.

Fig. 211.



6. Tetraconta-octahedron.

Fig. 212.



Mussa, Piedmont.

Irregular forms and grains.

Cleavage, parallel with the dodecahedron, but very indistinct. Fracture conchoidal, more or less perfect, generally uneven. Surface, the crystals sometimes streaked parallel to the edges of combination with the dodecahedron: the dodecahedron itself is sometimes streaked parallel to its edges of combination with the cube. The surface of the grains is uneven, rarely granulated.

Garnet.

Lustre vitreous, inclining to resinous in some varieties, more nearly the latter. Color red, brown, yellow, white, green, black; except some red colors, none of them are bright. Streak white. Transparent . . . translucent.

Hardness = 6·5 . . . 7·5. Sp. gr. = 3·615, Grossular; 3·701, Melanite; 3·769, brown, common Garnet; 3.788, Pyrope; 4·098, crystals of precious Garnet, Tyrol; 4·125, grains of precious Garnet, Ohlapian; 4·179, crystals of Almandine; 4·208, crystals of precious Garnet, Haddam.

Compound Varieties. Massive: composition granular, of various sizes of individuals, and often, even impalpable, easily separated, or strongly coherent; faces of composition irregularly streaked, uneven or rough. If the composition be impalpable, the fracture becomes uneven and splintery. The composition is sometimes thick lamellar, and bent, the face of composition being pretty smooth.

1. From the diversity in hardness and specific gravity, which exists among the numerous varieties of Garnet, it is highly probable that the present limits of the species are too wide, and that they include individuals which will hereafter be discovered to constitute independent species. It is not at all likely, however, that discoveries will take place in coincidence with the arbitrary and empirical separation of the species into varieties, as found in the older treatises of mineralogy; for these are founded almost entirely upon accidental circumstances. These subdivisions from their present currency in books, require to be noticed. *Grossular* occurs only in imbedded crystals of the forms of icositetrahedron, and combinations of it with the dodecahedron. Its colors are confined to asparagus green and mountain green. *Pyreneite* also occurs only in small blackish, imbedded crystals in limestone. *Melanite* possesses the form of modification 1, is generally imbedded, and of a velvet-black color. *Pyrope* occurs only in grains, and is remarkably distinct, from its pure translucency and blood red color, which is not found in any other variety. Among the varieties known under the simple denomination of Garnet, are found every simple form and combination noticed

above, among the crystalline varieties, also grains and massive specimens: it contains likewise every shade of the series of colors, and it is therefore only in the particular union of several of these properties, that we must look for the distinction of the above mentioned varieties. The color of *Precious Garnet* is always red; its crystals are found imbedded. It is the only variety that occurs in grains, and if compound, it presents lamellar composition. *Common Garnet* seldom occurs in red colors, and these are of dull shades; its crystals are generally implanted, and the composition is granular, but not impalpable. *Colophonite* is a compound variety of yellowish-brown and reddish-brown, or oil green and honey-yellow colors, consisting of roundish particles of composition, which are easily separable. If the composition be impalpable, Allochroite is formed. The two varieties *Aplome* and *Essonite*, appear less connected with the rest of the species, than any of those which have been enumerated. The first of these occurs in dodecahedrons, having the acute, solid angle replaced by tangent planes, parallel with which cleavage takes place, thus indicating the cube as the system of crystallization to which they belong. The latter, according to HAUY, presents traces of cleavage parallel to a prism of 101° 40′. It is generally found in grains; but the optical examinations of Dr. BREWSTER and M. BIOT, render it extremely probable that it is only a variety of Garnet.

2. Before the blow-pipe, Garnet melts without effervescence, pretty uniformly, into a black globule, presenting a vitreous lustre. Some varieties present a slight effervescence, but finally yield the same result. The bead obtained by melting is frequently attracted by the magnet.

3. *Analysis.*

	KLAPROTH.			SIMON.	VAUQUELIN.		KL. LAUGIER.		KL.
	Grossular.	Melanite.	pr. Garnet.	Colophonite.	Allochroite.	Pyreneite.	Pyrope.	Aplome.	Essonite.
Silica - -	44·00	35·50	35·75	37·00	35·00	43·00	40·00	40·0	38·80
Alumina - -	8·50	6·00	27·25	13·50	8·00	16·00	28·50	20·0	21·20
Lime - -	33·50	32·50	0·00	29·00	30·00	20·00	3·50	15·5	31·25
Ox. of iron - -	12·00	24·25	36·00	7·50	17·00	16·00	16·50	2·0	6·50
Ox. of manganese	a trace.	0·40	0·25	4·75	3·50	0·00	0·25	2 0	0·00

Besides these, Colophonite contains 6·5 p. c. of magnesia, 0·5 p. c. of oxide of titanium, and 1·0 of water; Allochroite, 6·0 of carbonate of lime; Pyreneite, 4·0 of water; and Pyrope, 10 of magnesia, and 2·0 of chromic acid.

4. Garnet occurs in many rocks with a degree of constancy, and in a quantity almost sufficient to be regarded as an essential ingredient in

their composition. It is particularly plentiful in mica-slate, gneiss, granite, and also exists, though in smaller quantity, in limestone, chlorite-slate, serpentine and lava. Precious Garnet occurs in slaty primitive rocks; Grossular and Pyrope are found in serpentine, the latter also in other rocks, through the decomposition of which it is brought into the soil. Melanite is imbedded in lava, and occurs implanted in geodes ejected by Vesuvius, also in primitive limestone. Pyreneite is found in a blackish limestone. Common Garnet is found in beds, consisting either wholly, or for the greater part of its varieties, accompanied by Magnetic Iron-Ore, Hornblende and Epidote. Allochroite is found under similar circumstances. Colophonite forms veins in primitive rocks.

5. Grossular is found with Idocrase in a kind of serpentine, in Kamtschatka; Melanite, at Frescati and Albano near Rome; Pyrope, near Bilin in Bohemia, and in the serpentine of Zöblitz, and the forest of Zell in Saxony; Pyreneite, near Barèges in France. Precious Garnet, sometimes in large, but not very transparent crystals, and often covered with a coat of chlorite, occurs at Fahlun in Sweden, and in many localities of the Tyrol, Carinthia, Stiria, Switzerland, Hungary, &c. The varieties possessing lamellar compositions, are found in Greenland; Common Garnet, in large quantities, at Arendal in Norway, Fahlun, Langbanshytta in Sweden, Orawitza in the Bannat in Hungary, Stiria, Siberia and many other places. Colophonite is known from Arendal; Allochroite from Drammen in Norway, and the valley of Zem in Salzburg. The transparent crystals of precious Garnet, called *Almandine*, are chiefly brought from Ceylon and Pegu, where they occur in the sand of the rivers. The Aplome comes from Lena in Siberia, Schwarzenberg in Saxony, and from Bohemia and England; the Cinnamon stone from Ceylon.

Several very beautiful varieties of Garnet have been found in the U. States. Small, but exceedingly perfect, dodecahedrons, of a handsome red-brown color, and transparent, occur at Hanover, (New Hampshire,) disseminated through hornblende-gneiss. Dark blood-red, and highly splendent crystals, (modification 3,) present themselves in geodes, in massive Garnet, Calcareous Spar, and Magnetic Iron-Ore, at Franconia, (N. H.) Splendid geodes, of a transparent, cinnamon-brown colored variety, (of modification 1,) are found, accompanied by Scapolite, in white limestone, at Carlisle, (Mass.): less remarkable specimens, also, of the same variety, occur at Boxborough in the same region. Geodes of Melanite, of great beauty, in which the crystals sometimes are above an inch in diameter, occur at Franklin furnace, in New Jersey, in limestone, as-

sociated with Quartz and greenish Feldspar. A rich, red colored Garnet, in irregular trapezohedrons, sometimes of considerable size, is found at Haddam, (Conn.) associated with Chrysoberyl, Automalite, and Columbite. Very perfect trapezohedrons, of a reddish brown Garnet, abound in mica slate, in Munroe, Washington, and several neighboring towns in Connecticut. Large dodecahedral crystals, of a dull red color, and not possessed of smooth faces, are found in chlorite slate, at Marlborough and New Fane, in Vermont: also in mica slate, in Chesterfield, (Mass.) A blackish brown variety, in large crystals, (of modification 1,) is found in limestone, at Lyme, (Conn.) Colophonite in large grains, possessing rich colors, constitutes a powerful vein, in gneiss, at Willsborough, (N.Y.) on Lake Champlain. At Roger's Rock, also, upon Lake George, is found a much finer grained variety, of yellow and red colors. Yellow and reddish, brown Garnet, is found, along with Franklinite, in limestone, at Franklin Furnace, in New York.

GAY LUSSITE. Peritomous Natron-Salt.

Primary form. Oblique rhombic prism. M on M=68° 50′. P on M = 96° 30′.

Cleavage, parallel with the faces of the primary form, perfect; most so, parallel with M. Fracture conchoidal.

Lustre vitreous. Color white. Transparent. Very brittle. Hardness =2·5. Sp. gr. =1·9.

1. When heated, it decrepitates. Before the blow-pipe, it melts rapidly. In nitric acid, it dissolves with a brisk effervescence, giving rise to crystals of nitrate of soda.

2. *Analysis.*

By Boussingault and Cordier.

Carbonate of soda	33·96
Lime	31·39
Water	32·20
Carbonic acid	1·45
Alumina	1·00

3. It is found in great abundance, disseminated in detached crystals through clay, near Lagunilla in Colombia.

GEHLENITE. Pyramidal Dystome-Spar.

Primary form. A right square prism.

Cleavage, in traces, parallel with the base.

Lustre resinous, inclining to vitreous. Color, different shades of grey, mostly yellowish; none of them bright.

Opake. Sometimes faintly translucent on the edges.

Brittle. Hardness = 5·5 ... 6·0. Sp. gr. = 3·029.

1. Before the blow-pipe, it fuses only in thin splinters. In borax, it is very slowly dissolved. It gelatinizes in heated muriatic acid.

2. *Analysis.*

	By Fuchs.	By Kobell.
Alumina	24·80	21·4
Silica	29·64	31·0
Lime	35·30	37·4
Oxide of iron	6 56	4·4
Magnesia	0·00	3·4
Water	3·30	2·0

3. It has been found on Mount Monzoni, in the valley of Fassa in the Tyrol, along with Calcareous Spar.

GIBBSITE. Staphyline Wavelline-Spar.

Irregular stalactites; tuberose masses.

Structure fibrous, the fibres radiating from the centre.

Lustre faint. Color greenish or greyish white. Translucent.

Hardness = 3·0 ... 3·5, but easily reduced to powder. Sp. gr. = 2·4.

1. Before the blow-pipe, it whitens, but is infusible.

2. *Analysis.*

	By Torrey.
Alumina	64·8
Water	34·7

3. It is found in very small quantity only, disseminated through a bed of Limonite, at Richmond, (Mass.)

Gilbertite.

Gieseckite.

Crystallized in six-sided prisms.

Cleavage not visible. Fracture uneven, splintery.

Lustre resinous, faint. Color olive-green, grey, brown.

Streak uncolored. Feebly translucent on the edges ... opake.

Hardness = 2·5 ... 3·0. Sp. gr. = 2·832.

1. *Analysis.*

By Stromeyer.

Silica	46·07
Alumina	33·82
Magnesia	1·20
Black oxide of iron	3·35
Oxide of manganese	1·15
Potash	6·20
Water	4·88

2. It occurs in Greenland, with Feldspar.

3. The above description probably applies to a variety of Mica, similar to Pinite.

Gilbertite.

Massive; foliated.

Lustre pearly. Color white, with a shade of yellow. Translucent.

Sectile. Hardness = 4·00? Sp. gr. = 2·648.

1. *Analysis.*

By Thomson.

Silica	45·155
Alumina	40·110
Lime	4·170
Magnesia	1·900
Protoxide of iron	2·430
Water	4·250

2. It occurs at St. Austle in Cornwall, and contains through its mass particles of Fluor, and what appears to be Apatite.

3. It is quite probable, that the above mineral, which is well known as Cornish Talc, is an aggregate of Talc, Mica and several other mineral species.

Giobertite. (See *Magnesite.*)

GISMONDIN. Abrazitic Kouphone-Spar.

Primary form. Right square prism.

Secondary form. Primary form surmounted by four-sided pyramids, whose faces correspond to the prismatic faces. The adjoining faces of either pyramid incline under 122° 58′: and a face of the upper pyramid to a corresponding one of the lower, under 85° 40′.

Cleavage imperfect, parallel to the pyramidal faces. Surface, prismatic faces frequently rounded; the pyramidal ones smooth, and though generally very small, yet possessing high degrees of lustre. Fracture conchoidal.

Lustre adamantine. Color pale smalt-blue, milk-white, pearl-grey and rose-red. Translucent, in small crystals, nearly transparent.

Hardness =6·0...6·5. Sp. gr. =2·16...2·2.

1. Before the blow-pipe, it phosphoresces, and becomes friable, but is infusible. It gelatinizes with acids without effervescence.

2. *Analysis.*
By Carpi.

Silica	41·4
Lime	48·6
Alumina	2·5
Magnesia	1·5
Oxide of iron	2·5

3. Gismondin occurs along with white octahedrons of Fluor, Feldspar and other minerals, in the drusy cavities of a volcanic rock, at Capo di Bove, near Rome.

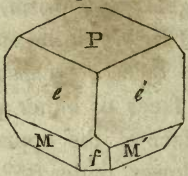
It approaches in several of its properties, especially that of form, the species Zircon.

GLAUBERITE. Prismatic Brithyne-Salt. Mohs.

Primary form. Oblique rhombic prism. M on M′=83° 20′. M on P =104° 15′.

Secondary form.

Fig. 213.



P on e or e'	137°	9′	Phillips	M on e	147°	40′
e on e'	116	20		P on f	112	20
M or M′ on f	131	35		e or e' on f	132	37

The planes M and f are often wholly wanting.

Cleavage, parallel with M and M′ perfect; traces of P but interrupted by conchoidal fracture. Fracture conchoidal. Surface, planes e streaked parallel to their common edges of combination, partly uneven, but smooth and shining.

Lustre vitreous. Color yellowish or greyish-white. Streak white. Semi-transparent . . . translucent.

Brittle. Hardness = 2·5 . . . 3·0. Sp. gr. = 2·807.

Taste feebly saline and astringent.

1. Before the blow-pipe, it decrepitates, and melts into a white enamel. Immersed in water, it loses its transparency, and is partly dissolved. The same appears in a moist atmosphere.

2. *Analysis.*

By Brongniart.

Sulphate of lime	49·0
Sulphate of soda	51·0

3. It occurs in imbedded crystals in Common Salt, at Villarubia, near Ocana in New Castile. Another locality is Aussee in Upper Austria.

GLAUBER SALT. Prismatic Glauber-Salt. Mohs.

Efflorescent, and in mealy crusts.

Glauber Salt.

Lustre vitreous. Color white. Streak white. Transparent to opake.

Sectile. Hardness = 1·5 . . . 2·0. Sp. gr. = 1·481. Taste cool, then feebly saline and bitter.

1. It is easily soluble in water, but readily falls into powder on being exposed to the air.

2. *Analysis.*

By Reuss.

Sulphate	of soda	67·024
Carbonate	of soda	16·333
Muriate	of soda	11·000
Muriate of lime		5·643

3. Glauber Salt is found accompanying Common Salt and Epsom Salt, or as an efflorescence, upon the soil, and on several rocks; also on the shores of salt lakes, and in some mineral springs.

4. It occurs in the neighborhood of Ausser, Ischel, and Hallstadt in Austria, at Hallein in Salzburg, in Hungary, in Switzerland; also in Italy and Spain, and the Sandwich Islands.

Glaucolite.

Massive. Cleavage parallel with a rhombic prism of 143° 30′, nearly. Fracture splintery, or uneven.

Lustre vitreous. Color lavender-blue, to green. Translucent. Hardness = 5·5. Sp. gr. = 2·7 . . . 2·9.

1. Fusible with difficulty before the blow-pipe, into a blebby white glass; but is soluble in borax and salt of phosphorus.

2. *Analysis.*

By Bergmann.

Silica	54·58
Alumina	29·77
Lime	11·08
Potash	4·57

3. It is found in compact Feldspar and granular limestone, with Talc, in the granitic mountains, upon the borders of the Sliudianka, which empties into lake Baikal.

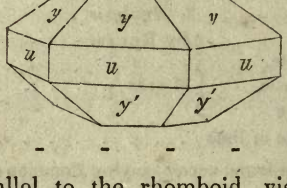
4. With the exception of the cleavage, the foregoing description would apply to some of the varieties of Scapolite.

GMELINITE. Sarcoline Kouphone-Spar.

Primary form. Rhomboid : dimensions unknown.

Secondary form. Regular hexagonal prism, with the terminal edges replaced by single planes.

Fig. 214.



y on y' - - - - 83° 36′

Cleavage parallel to the rhomboid, visible, though not easily obtained. Fracture uneven. Surface streaked, the prism horizontally, the pyramidal planes parallel to the edges of combination with the rhomboid.

Lustre vitreous. Color white, passing into flesh-red. Streak white. Translucent.

Hardness =4·5. Sp. gr. =2·05.

1. Before the blow-pipe, it swells up, and assumes the appearance of an enamel. When held in the flame of a candle, it exfoliates into numerous scales.

2. *Analysis.*

	By Vauquelin,		By Thomson,
	fr. Montecchio-Maggiore.	fr. Castel.	fr. Antrim, Ireland.
Silica	50·00	50·00	39·896
Alumina	20·00	20·00	12·968
Lime	4·50	4·25	0·000
Soda	4·50	4·25	0·000
Water	21·00	20·00	29·866
Protoxide of iron	0·00	0·00	7·443
Potash	0.00	0·00	9·827

3. It is found in the cavities of amygdaloidal rocks, at Montecchio-Maggiore, and at Castel in the Vicentine, and in the county of Antrim in Ireland.

4. It would appear that the newly proposed *Ledererite*, from Cape Blomidon, Nova Scotia, is a variety of Gmelinite. It is described by Mr. JACKSON as occurring in regular six-sided prisms, whose terminal edges are truncated, the truncating planes inclining to the prismatic faces under angles of 180°, i. e. y on y' (of the above figure) $= 80°$; a difference not very considerable, when it is considered that the common goniometer was employed. The crystals, besides, are mentioned as having the longitudinal striæ upon the prismatic faces. Sp. gr. = 2·169. Hardness nearly the same as Feldspar, though from the circumstance that Mr. BROOKE considered the mineral as Apatite, it seems probable that it must be somewhat lower. The crystals are transparent, or only translucent; white, or tinged with flesh-red. Lustre vitreous. According to Mr. HAYES, it consists of, Silica 49·470, Alumina 21·480, Lime 11·480, Soda 3·940, Phosphoric acid 3·480, Oxide of iron 0·140, Foreign matter 0·030, Water 8·580, Loss 1·400. This mineral occurs in trap, with Analcime and Stilbite.

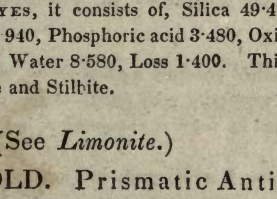
GŒTHITE. (See *Limonite*.)

GRAPHIC GOLD. Prismatic Antimony-Glance. MOHS.

Primary form. Right rhombic prism. M on M = 107° 44′.

Secondary form.

Fig. 215.



P on $a1$	141°	30′	PHILLIPS.	P on $c3$ or $c3'$	132°	45′
P on $a2$	129	12		M on h	126	08
P on $c1$ or $c1'$	151	40		f on h	90	00
P on $c2$ or $c2'$	136	42				

Cleavage parallel with M highly perfect; with T perfect, though not so easily obtained. Fracture uneven.

Graphic Gold.

Secondary surfaces of the prism vertically streaked; M fused-like; the remaining faces smooth.

Lustre metallic. Color pure steel-grey. Streak unchanged.

Very sectile. Hardness = 1·5 ... 2·0. Sp. gr. = 5·723.

Compound Varieties. Regular composition of acicular crystals, nearly at angles of 60° and 120°, in one plane, frequently repeated, and imparting to the whole the appearance of certain characters for writing. Massive: composition imperfectly columnar or granular, small, but not impalpable.

1. The present species presents a great many varieties of crystalline forms, which being generally very much engaged among each other, and moreover modified by regular composition, have not yet been satisfactorily developed.

Before the blow-pipe, it melts easily into a dark grey metallic globule, and covers the charcoal with a white oxide, which changes into a green, or bluish green, when the reduction flame is directed upon it. After having continued the blast for some time, a ductile metallic metal, of a light yellow color, remains.

2. *Analysis.*

By KLAPROTH.

Tellurium - - - -	60·00
Gold - - - -	30·00
Silver - - - -	10·00

It yet remains to be explained how an amalgam of the above composition should possess a sp. gr. of only 5·723, when the artificial preparation would mount as high as 10.

3. Graphic Gold occurs at Offenbanya in Transylvania, in very narrow, but quite regular veins, which traverse porphyry, several of them at a short distance from each other, and parallel. It is accompanied by Native Gold and Quartz; and is occasionally met with along with Black Tellurium, at Nagyag in Transylvania.

4. It is a valuable ore, on account of its richness in gold and silver.

GRAPHITE. (See *Plumbago.*)

GREEN EARTH. (See *Talc.*)

GREEN IRON-ORE.

Massive: reniform and fibrous.

Lustre vitreous, silky. Feebly translucent upon the edges. Color dark lake-green; the decomposed fibres, yellowish or brownish.

1. It yields water on being heated, and melts very easily into a black porous slag, which is not magnetic. It is soluble in muriatic acid.

2. *Analysis.*

By KARSTEN.

Phosphoric acid	28·50
Oxide of iron	62·52
Water	8·98

3. It occurs in the Hollester mines near Siegen, in Prussia.

GREEN LEAD-ORE. (See *Pyromorphite.*)

GREEN MALACHITE. Habroneme Copper-Baryte.

Primary form. Oblique rhombic prism. M on M′ = 103° 42′. P on the obtuse edge of the prism = 118° 11′.

Secondary form. The primary, having the obtuse edge of the prism truncated.

Cleavage, highly perfect in the direction of P; that parallel with the obtuse edge of the prism, or longer diagonal, less distinct. Fracture conchoidal, uneven, scarcely observable in crystallized varieties. The secondary plane upon the obtuse edge sometimes streaked, the other faces smooth.

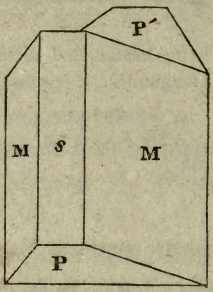
Lustre adamantine, inclining to vitreous. Color grass-green, emerald-green, verdigris-green. Streak green, rather paler than the color. Translucent, sometimes only on the edges.

Brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 4·008.

Green Malachite.

Compound Varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel with the longer diagonal of the prism; angle of revolution $=180°$.

Fig. 216.



This composition occurs in almost every variety, and even in those masses which consist of columnar particles of composition. It then seems as if both the faces of a prism were present, forming a dihedral termination of each individual of 123° 37, while in fact there exists only one of them. Fascicular aggregations of delicate crystals. Tuberose, globular, reniform, botryoidal and stalactitic shapes: surface drusy, rough, sometimes smooth; composition columnar, generally very thin, often impalpable. Very thin columnar composition, produces a satiny lustre; impalpable composition, is the cause of conchoidal fracture. Massive: composition as above. The composition often repeated; granularly compound masses consist of columnar ones radiating from a centre; curved lamellar ones are likewise composed of thin columnar indiviuals. The surface of the second composition is often rough, and particularly in curved lamellar compositions, covered with a white coating.

1. Before the blow-pipe, it decrepitates, becomes black, and is partly infusible, partly converted into a black scoria. It is easily soluble in bo-

rax, imparting to it a deep green color, and yielding a globule of metallic copper. It is soluble, without residue, in nitric acid.

2. *Analysis.*

	By KLAPROTH.	By VAUQUELIN.
Copper	58·00	56·10
Oxygen	12·50	14·00
Carbonic acid	18·00	21·25
Water	11·50	8·75

3. It occurs in the same repositories as Blue Malachite, with which it is frequently associated. Beautiful varieties of Green Malachite are found at Chessy in France, in Siberia, and at Moldavia in the Bannat of Temeswar. The compact Malachite is chiefly found at Schwatz in Tyrol. Green Malachite occurs in Cornwall, Cumberland and Wales, England.

It is found in the United States, at several places, though no where in very handsome specimens. The most interesting localities are in Maryland, in the Blue Ridge in Pennsylvania near Nicholson's Gap, and at the Perkiomen Lead Mine, and in New Jersey at Schuyler's mines, where it is accompanied by Red Copper-Ore.

4. Those varieties which are sufficiently compact, are cut into vases, snuff boxes, ring-stones and other ornaments. Others are used as pigments. If it occurs in sufficient quantity, it is a valuable ore for the extraction of copper.

GREY ANTIMONY. Prismatoidal Antimony-Glance. MOHS.

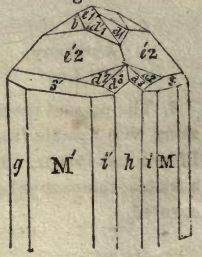
Primary form. Right rhombic prism. M on M = 91° 10′. (90° 45′. MOHS.)

Secondary form.

M′ on M	88°	40′
M′ on *e*′2, or M on *e*2	145	30
M′ or M on *h*	134	20
M′ on *i*′ or M on *i*	171	40
M′ on *g*	173	00
e′2 on *e*2	108	30
h on *e*′2 or *e*2	125	30
h on *i*′ or *i*	161	30

PHILLIPS.

Fig. 217.



Grey Antimony.

Cleavage, highly perfect in the direction of *h*, or the shorter diagonal of the prism; much less distinct parallel with M. Fracture small conchoidal, rather imperfect. Surface, the vertical planes deeply striated parallel to their own intersections, and rough. The remaining faces generally smooth. Subject to tarnish.

Lustre metallic. Color lead-grey, inclining to steel-grey. Streak unchanged.

Sectile. Thin laminæ are a little flexible. Crystals sometimes bent. Hardness =2·0. Sp. gr. =4·62.

Compound Varieties. Massive; composition columnar, of various sizes of individuals, sometimes very thin, but not impalpable. They are long and straight, either parallel or divergent from several common centres, and aggregated in a second angulo-granular composition. The faces of composition are irregularly streaked in a longitudinal direction. Sometimes the composition is granular, and then the individuals often become impalpable, but are generally very strongly connected; the fracture becomes even or uneven. Capillary crystals often form a tissue resembling wool, or felt.

1. Grey Antimony is very fusible before the blow-pipe, and is absorbed by the charcoal. By a continued blast, it may be valatilized, without leaving any considerable residue.

2. *Analysis.*

	By Proust.	By Thomson.
Antimony	75·00	73·77
Sulphur	25·00	26·23

3. The present species occurs in veins and beds: in the latter case along with Spathic Iron. It is frequently associated with Heavy-Spar, Blende and Quartz. Its decomposition produces the *Antimony-Ochre*, a friable, compact yellow substance, with which it is often associated or covered.

4. Veins, consisting almost entirely of the present species, have been discovered at Pösing near Pressburg in Hungary, and at Wolfsthal in the county of Stollberg in the Hartz; also such as contain considerable quantities of it associated with other minerals, at Felsobanya in Upper Hungary, at Cremnitz, Schemnitz, and other places in Lower Hungary, and in France. Other localities are Bräunsdorf near Freiberg in Saxony, Neudorf in Anhalt, Cornwall and Scotland. The fibrous variety occurs at Loben in the valley of the Levant in Carinthia, and the compact at Magurka in Hungary.

5. It is used for extracting the crude antimony, or the metal itsef, which is employed in the manufacture of several metallic alloys, and in medicine.

Appendix to Grey Antimony.

i. *Haidingerite.* Berthier.

Massive; sometimes exhibiting appearances of prismatic crystals, but generally in confusedly aggregated masses, whose structure is foliated.

Lustre feeble, metallic. Color iron-grey, with tarnished hues.

1. Before the blow-pipe, it melts readily. It is quickly acted upon by cold muriatic acid, giving out pure sulphuretted hydrogen; and is totally dissolved except some Pyrites and Quartz.

2. *Analysis.*

By Berthier.

Sulphur	30·8
Antimony	52·0
Iron	16·0
Zinc	0·3

3. It occurs along with Quartz, Calcareous Spar and Iron-Pyrites, at Chazelles in France.

4. It has until lately been rejected as an ore of antimony, on account of the impurity of the metal obtained.

5. It is probable that this mineral is nothing more than an impure variety of Grey Antimony.

Grey Manganese. (See *Pyrolusite*, *Manganite* and *Psilomelan.*)

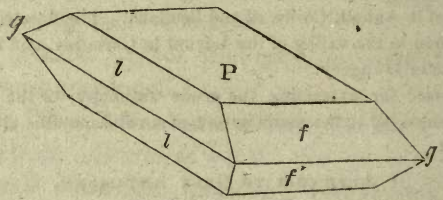
Gurhofian. (See *Dolomite.*)

GYPSUM. Prismatoidal Gypsum-Mica.

Primary form. Right oblique angled prism. M on T $=113° 8'$.

Secondary forms.

Fig. 218.



Oxford, England—Ohio.

Fig. 219.

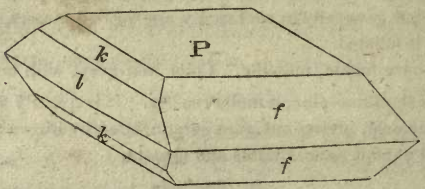


Fig. 220.

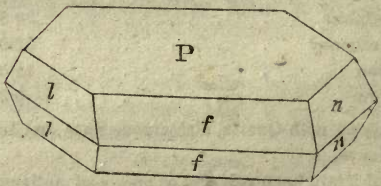


Fig. 221.

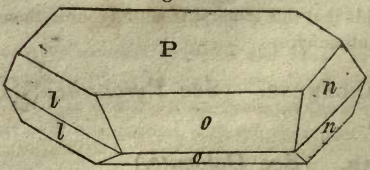
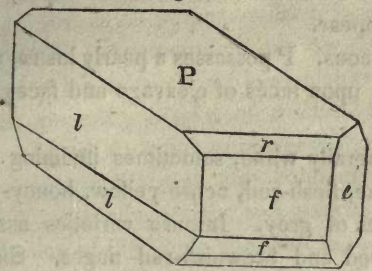


Fig. 222.



Bex, Switzerland.

Fig. 218. Primary form, having the longer and shorter terminal edges replaced. P on $l = 108° 3' 19''$. P on $f = 124° 41' 43''$. f on $f = 110° 36' 34''$. l on $l = 143° 53' 22''$. (*trapezienne.* Hauy.)—Fig. 219. The same, altered only through the additional planes k. P on $k = 134° 21' 40''$. k on $l = 153° 41' 39''$. (*progressive.* Hauy.)—Fig. 220. The same as Fig. 218, with the addition of planes n through the replacement of the acute terminal angles. (*équivalente.* Hauy.)—Fig. 221. The same with Fig. 220. excepting the substitution of planes o for f. o on $o = 71° 40' 32''$. (*quaterno bisunitaire.* Hauy.)—Fig. 222. Like Fig. 218. with the addition of planes r, and the truncation of the acute, lateral edges. (*disjointé.* Hauy.)

Cleavage, parallel with P highly perfect, and easily obtained; with M and T imperfect, the former of these being of a conchoidal appearance, while the former is obtained with difficulty, on account of the flexibility of the mineral in that direction, and often presents a fibrous aspect. Fracture scarcely perceptible.

Surface. P and l streaked, parallel to their common intersections. The faces e and f often rounded, which

gives rise to the well known lenticular shapes, if the faces P and *l* disappear.

Lustre vitreous. P possesses a pearly lustre, more or less distinct, both upon faces of cleavage and faces of crystallization.

Color, generally white, sometimes inclining and passing into smalt-blue, flesh-red, ochre-yellow, honey-yellow, and several shades of grey. Impure varieties assume dark-grey, brick-red and brownish-red tinges. Streak white. Transparent . . . translucent.

Sectile. Thin laminæ are flexible in the direction of those edges which arise from the intersection of P with *r*.

Hardness $=1{\cdot}5 \ldots 2{\cdot}0$. The lowest degrees upon P, its highest degrees in the direction in which the crystals are rounded. Sp. gr. $=2{\cdot}310$.

Compound Varieties. Twin-crystals. 1. Axis of revolution perpendicular, face of composition parallel to M. Angle of revolution $= 180°$, (as in the annexed figure,) which is understood, if we suppose fig. 220. to possess, instead of the edge from the meeting of *f f*, a portion of M, and the bisection to take place through P.

Fig. 223.

2. Axis of revolution perpendicular to M; face of composition parallel to P: angle of revolution $=180°$.

Gypsum.

3. Axis of revolution perpendicular; face of composition parallel to T. According to this law are formed the arrow-shaped twins, consisting of lenticular crystals. Globular masses, generally formed of discernible individuals. Dentiform. Massive: composition granular, passing into impalpable, sometimes scaly; also columnar, often as thin as hair, long, generally straight and parallel. Sometimes without cohesion of the single particles, in the state of powder.

1. Before the blow-pipe, it exfoliates and melts, though with difficulty, into a white enamel, which after a short time falls into powder. In a lower degree of heat, it loses its water and becomes friable, so as to be easily reduced to an impalpable powder. If mixed with water, this powder becomes warm, and soon hardens into a solid mass.

2. *Analysis.*

By Bucholz.

Lime	33·0
Sulphuric acid	44·8
Water	21·0

3. Compound varieties of Gypsum form beds in secondary mountains, more sparingly in the older classes of rocks; and they are generally possessed of a considerable thickness. Its principal repositories are sandstones and clay, in which it is associated with limestone and Common Salt. Brine springs very often issue from the rocks in its vicinity. Simple varieties are chiefly found in clay, in salt works; also in abandoned mines and old heaps, where they are often products of recent origin.

4. Gypsum is found in almost all countries, both crystallized and massive; for example, in Mansfeld, Thuringia, Bavaria, Franconia, Swabia, Switzerland, in the Tyrol, Stiria and Austria; also Poland, Hungary and Transylvania; in England, France, Spain. Beautiful crystals are found near Oxford, at Bex in Switzerland, Hall in the Tyrol, and at Ischel; large lenticular crystals, generally twins, occur at Montmartre, near Paris. Gypsum occurs in great quantities in Nova Scotia, both the earthy varieties and the scaly. In the United States, this species is abundant in Arkansaw, Illinois, Tennessee, Virginia, Ohio and N.York. At Poland, in Trumbull co. (Ohio,) exceedingly perfect and transparent

crystals, several inches long, of the form of Fig. 218, are found. Near Niagara falls, and at Lockport, (N.Y.) very handsome varieties of snowy white, granular, and foliated Gypsum, occur imbedded in black limestone.

5. Gypsum is variously employed in manufacturing artificial marble, stucco work, mortar, &c.; also for making casts of statues, medals, &c. It is added to the mass of certain kinds of porcelain and glass. In sculpture, it is used under the name of alabaster. It is also employed in agriculture, for improving the soil, both calcined, and in its natural state; it forms the paste of colored drawing pencils, and is employed in polishing.

GUMMITE. (See *Halloysite.*)

HAIDINGERITE. Diatomous Gypsum-Mica.

Primary form. Right rhombic prism. M on M = 99° 52′.

Secondary forms. The primary, having the lateral and terminal angles replaced by single planes, together with the truncation of the obtuse lateral edges, and the bevelment of the lateral edges. The obtuse edges of the prism are sometimes replaced by three planes.

Cleavage, highly perfect, and easily obtained in the direction of P.

Lustre vitreous. Color white. Streak white. Transparent, in small crystals translucent. Double refraction observable through M, and the opposite face replacing the obtuse edge, making an angle of 40°.

Sectile. Thin laminæ, slightly flexible.

Hardness = 2·0 ... 2·5. The face P may be scratched by Common Salt. Sp. gr. = 2·848.

1. *Analysis.*
By TURNER.

Arseniate of lime	-	-	-	85·681
Water	-	-	-	14·319

2. It has been observed only upon a single specimen, whose locality is unknown, in the cabinet of Mr. FERGUSON, of Raith. The mineral

forms crystalline coats, of a somewhat botryoidal appearance, over a ferruginous Quartz, which covers a rose red variety of Diallogite, resembling that found near Freiberg. The same specimen also contained large crystals of Pharmacolite.

HAIDINGERITE of BERTHIER. (See *Grey Antimony.*)

HALLOYSITE.

Reniform and tubercular masses. Massive; composition impalpable. Fracture conchoidal.

Lustre resinous. Color pure white, or tinged with blue. Translucent on the edges. In water becomes transparent.

Sectile, may be indented by the nail, and polished with the finger.

1. *Analysis.*
By BERTHIER.

Silica	44·94
Alumina	39·06
Water	16·00

It is found in masses three or four inches in diameter, among ores of iron, zinc and lead, in cavities of transition limestone, at Angleure, near Liège.

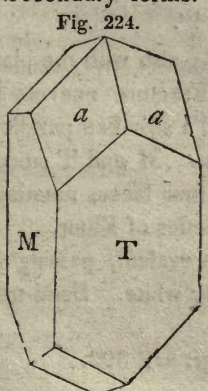
HARD COBALT PYRITES. (See *Cobaltine.*)

HARMOTOME. Paratomous Kouphone-Spar. MOHS.

Primary form. Right rectangular prism.

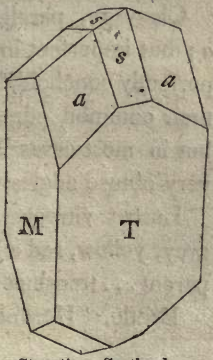
Secondary forms.

Fig. 224.



Oberstein.

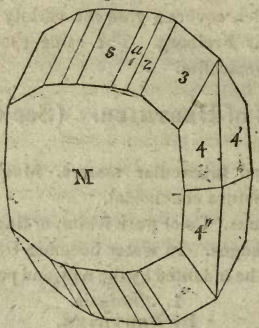
Fig. 225.



Strontian, Scotland.

Harmotome.

Fig. 226.



M on *s*	- - -	125°	5′ P.
s on *s* over the summit	-	110	26
s on *a*1	- - -	171	4
s on *a*2	- - -	151	35
s on *a*3	- - -	149	32
*a*4 on *a*4′	- - -	177	28

Fig. 224. Primary form, with the solid angles truncated. *a* on *a* = 121° 57′ 56′. *a* on *a* over the summit, = 86° 36′.

Fig. 225. *s* on T = 123° 41′ 24″.

Cleavage, parallel with M and T; also with the planes *a*; but imperfect in all directions. Fracture uneven, imperfectly conchoidal. Surface, *a* and *s* streaked parallel to their common edges of combination. M and T smooth, but in most cases T is divided into four faces, meeting at very obtuse angles, as in certain varieties of Fluor.

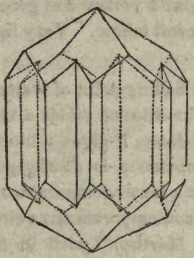
Lustre vitreous. Color white prevalent, passing into grey, yellow, red and brown. Streak white. Semi-transparent . . . translucent.

Brittle. Hardness = 4·5. Sp. gr. = 2·392.

Harmotome.

Compound Varieties. Twin-crystals. Face of composition parallel, axis of revolution perpendicular to one of the faces of M and T. The individuals are continued beyond the face of composition, and produce the cruciform crystals. (See annexed figure.)

Fig. 227.



Massive: composition granular, rare.

1. Alone upon charcoal, it melts, without intumescence, into a clear globule. It phosphoresces with a yellow light, and is not easily acted upon by acids.

2. *Analysis.*

	By Klaproth.	By Wernekink.	By Thomson.
	fr. Andreasberg.	fr. Schiffenberg.	fr. Strontian.
Silica	49·00	44·79 - 53·07	48·735
Alumina	16·00	19·28 - 21·31	15·100
Baryta	18·00	17·59 - 0·39	14·275
Lime	0·00	1·08 - 6·67	3·180
Potash	0·00	0·00 - 0·00	2·550
Ox. iron and mang.	0·00	0·85 - 0·56	0·000
Water	15·00	15·32 - 17·09	14·000

3. Harmotome occurs in metalliferous veins, traversing grey-wacke and mica-slate, and in the vesicular cavities of amygdaloidal rocks.

4. The beautiful, cruciform twins occur at Andreasberg in the Hartz; and the simple crystals at Strontian, in Scotland. Other localities are, Kongsberg in Norway, Oberstein in Deuxponts, where it is found in agate balls; Baden, near Engelhaus and Buchan in Bohemia, and in the

vicinity of Mount Vesuvius. It is also said to occur very frequently in amygdaloid, in Scotland.

HATCHETINE.

In the shape of flakes like spermaceti, or of granular masses like bees-wax.

Lustre slightly glistening and pearly, and of considerable degrees of transparency when in flakes, else dull and opake. Color yellowish-white, wax yellow and greenish-yellow.

Hardness, like soft tallow. Very light. Without odor or elasticity.

1. It melts below the boiling point of water. Ether dissolves it readily; being evaporated, the solution yields a viscid, oily inodorous matter. Distilled over the spirit-lamp, it gives a bituminous smell, a greenish-yellow, butryaceous substance is disengaged, and a coaly residue remains in the retort. At a lower temperature a light oil is distilled.

2. It occurs in small contemporaneous veins with Quartz, Calcareous Spar and iron-ores, at Merthyr Tydril in South Wales. It has been described by Mr. BRANDE under the denomination of *Mineral Adipocire*.

3. The description of Hatchetine agrees very nearly with the following one given of *Mountain Tallow*. It has the color and feel of tallow, and is tasteless; its sp. gr. = 0·6078, in its natural state, but is increased by melting it, to 0·983, the air bubbles being driven off. It melts at 118°, and boils at 290°. When melted it is transparent and colorless, but becomes opake and white on cooling. It is insoluble in water, but is dissolved by alcohol, oil of turpentine, olive-oil and naphtha, when hot, but is precipitated when they cool. It does not form soap with alcaline substances, but is combustible. It has been found in a bog, on the borders of Loch Fyne, and has been formerly noticed on the coast of Finland, in one of the Swedish lakes; near Strasburg, and in Scotland.

HAUSMANNITE. (See *Black Manganese*.)

HAUYNE. (See *Sodalite*.)

HAYDENITE. (See *Chabasie*.)

HAYTORITE.

A variety of Quartz, resembling Calcedony, in perfect crystals, single and variously aggregated, and having the form of Datholite, (variety Humboldtite.) It occurs in detached pieces, ac-

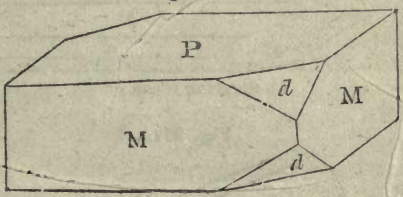
companied by small masses of Calcedony, Garnet, green Hornblende, Talc and Magnetic Iron-Ore—the aggregate being enveloped by a ferruginous clay, and existing in an iron mine adjacent to the Hay Tor granite quarries, in Devonshire. The formation of these crystals is quite inexplicable according to the known laws of pseudomorphism.

HEAVY SPAR. Prismatic Hal-Baryte. Mohs.

Primary form. Right rhombic prism. M on M′=101° 42′.

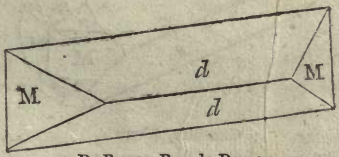
Secondary forms.

Fig. 228.



Cheshire, (Conn.)

Fig. 229.



De Roure, Puy de Dome.

Fig. 230.

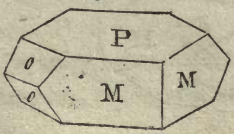
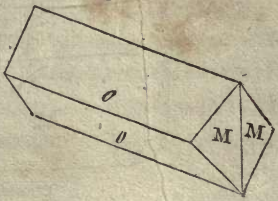
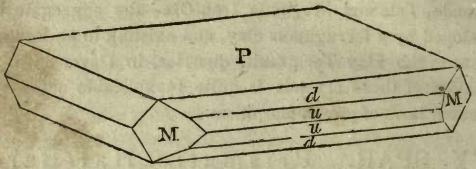


Fig. 231.



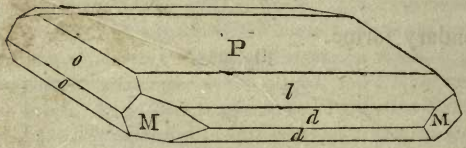
Heavy Spar.

Fig. 232.



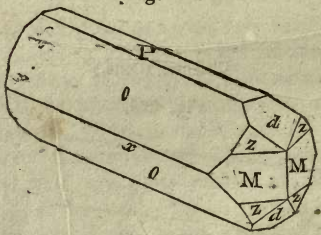
Cheshire, (Conn.)

Fig. 233.



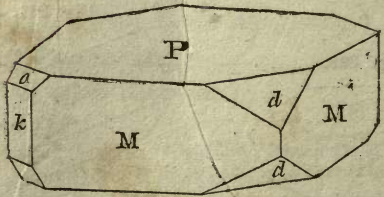
Cheshire, (Conn.)

Fig. 234.



Cheshire, (Conn.)

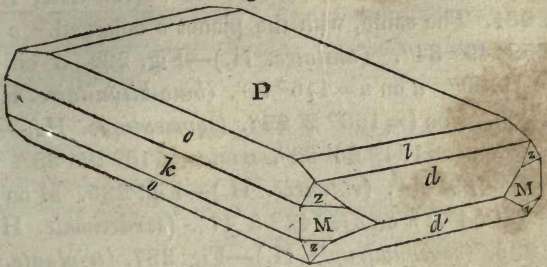
Fig. 235.



Cheshire, (Conn.)

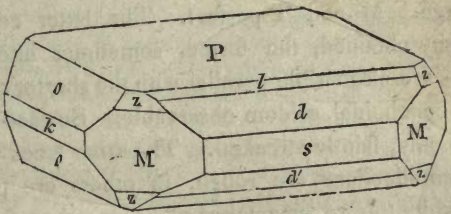
Heavy Spar.

Fig. 236.



Cheshire, (Conn.)

Fig. 237.



Cheshire, (Conn.)

Fig. 238.

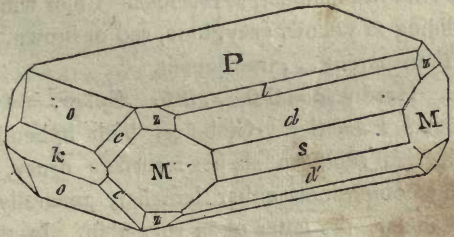


Fig. 228. Primary form, with its obtuse angles truncated. P on $d = 140° 59' 21''$. (*apophane*, H.)—Fig. 229. The same, with the faces d enlarged. d on $d = 78° 1' 58''$. (*binaire*, H.)—Fig. 230. Primary form, with its acute an-

gles truncated. P on $o=127° 5' 13''$. (*emoussée*, H.)—Fig. 231. The same, with the planes *o* enlarged. *o* on *o* $=105° 49' 34''$. (*unitaire*. H.)—Fig. 232. *d* on *u* $=160° 41' 39''$. *u* on *u* $=116° 38'$. (*bino-bisunitaire*. H.)—Fig. 233. *d* on *l* $=163° 2' 22''$. (*soussextuple*. H.)—Fig. 234. M on *z* $=154° 26' 52''$. *z* on *z* $=110° 25' 38''$. *o* on *z* $=135° 39' 58''$. (*entourée*. H.)—Fig. 235. M on *k* $=129° 13' 54''$. *k* on *o* $=142° 8' 47''$. (*sexdecimale*. H.)—Fig. 236. (*sousquadruple*. H.)—Fig. 237. (*triplante*. H.)—Fig. 238. *c* on *o* $=166° 46' 49''$. M on *c* $=133° 31' 31''$. (*diplonome*. H.)

Cleavage. M and T perfect. The latter commonly more easily obtained, the former sometimes interrupted. Cleavages are also visible parallel with the shorter diagonal. Fracture conchoidal, seldom observable. Surface in a few examples only, faintly streaked. The same faces which in certain modifications are rough, in others are perfectly smooth, while the reverse takes place in other faces; so that they do not constantly present the same appearances.

Lustre vitreous, inclining to resinous. Color white, prevalent, inclining to yellow, grey, blue, red or brown. Streak white. Transparent . . . translucent.

Brittle. Hardness $=3{\cdot}0 \ldots 3{\cdot}5$. Sp. gr. $=4{\cdot}446$.

Compound Varieties. Globules, both imbedded and implanted, also reniform shapes: surface drusy, uneven and rough; composition either lamellar, generally imperfect or columnar, the latter often very thin. In the reniform shapes, the curved lamellar particles of composition consist of imperfectly straight lamellar, or of columnar ones. Massive: composition as in the imitative shapes, more frequently the distinctly straight lamellar masses are aggregated

in a granular composition. The composition is sometimes granular, and even impalpable. Without coherence of the particles, friable.

1. It decrepitates when suddenly heated before the blow-pipe, and fuses with difficulty. Several varieties emit a phosphorescent light, if carefully heated, and retain this property for some time after cooling. In the interior flame, it assumes a burning, hepatic taste.

2. *Analysis.*

By BERTHIER.

Baryta - - - - -	66·00
Sulphuric acid - - - - -	34·00

Several varieties contain substances foreign to this mixture, which must be considered as impurities, as silica, oxide of iron, alumina, &c. Crystals of Heavy Spar have been artificially obtained by dissolving sulpho-cyanuret of barium in sulphuric acid, and allowing this solution to be slowly decomposed by the influence of the atmosphere; they are in the form of the primary; having angles of 101° 42′ and 78° 18′.

3. Many varieties of Heavy Spar, but more particularly the granular and compact ones, occur in beds, accompanying Galena and Blende; others are found in iron ores. It is frequently met with in veins, in rocks of various ages, either with the above mentioned, or with cupriferous, minerals; also with manganese ores, Grey Antimony, and Realgar.

4. Large and beautiful crystals have been found in the mines of Cumberland, Durham and Westmoreland, in England; also at Felsöbanya and Cremnitz in Hungary, at Freiberg, at Marienberg and other places in Saxony, at Pzribram and Mies in Bohemia, at Roya and Roure in Auvergne. A radiated variety, in imbedded globules, is found at Monte Paterno, near Bologna. The *Calcareous Heavy-Spar* of BREITHAUPT, is a variety of the present species, found near Freiberg. It contains a little sulphate of lime, in consequence of which its sp. gr. is only 4·2.

The deposits of this species are too numerous in the United States to be enumerated; only a few of the more important can be mentioned. The curved lamellar varieties are abundant at the Southampton lead mines in Massachusetts, and in several similar places in the vicinity. In Connecticut, similar varieties are found in connection with the trap and sandstone at Berlin, Farmington, and Southington. But the most interesting locality is at Cheshire, where it occurs in distinct crystals, as well

as in foliated masses, associated with crystallized Quartz, Green Malachite and Vitreous Copper, all of which minerals are imbedded in sandstone. An extremely delicate, fibrous, nearly compact variety, is found in great abundance, at Pillar Point, Jefferson co. near Sacket's Harbor, (N.Y.) where it forms large veins. Its colors are reddish-brown, and yellowish and greyish white. At the Perkiomen lead-mine in Pennsylvania, are found the foliated, the compact and the earthy varieties. Heavy Spar is extremely abundant in the Missouri lead-mines, and throughout the southern and western States generally. It occurs at Schoharie, (N. Y.) associated with Strontianite in the water-limerock.

5. Little use has heretofore been made of Heavy Spar. Pure white varieties are used as a white paint, either alone, or mixed with white lead. The fibrous variety of various colors, from Pillar Point, (N. Y.) has been sawn into moderately sized slabs, and polished; many of which present a very handsome appearance.

HEDENBERGITE. (See *Pyroxene*.)

HEDYPHANE. Hedyphanous Lead-Baryte.

Massive: composition granular and impalpable. Fracture small and imperfectly conchoidal; occasionally exhibiting little fissures.

Lustre adamantine to resinous. Color, greyish white. Translucent.

Hardness = 4·5 . . . 5·0. (Scale of BREITHAUPT.) Sp. gr. = 5·461 . . . 5·498.

1. Before the blow-pipe, it melts into a white frit, but less easily than the Mimetene. The lead is not reduced, even in the strongest heat of the reduction flame; nor does the resulting mass assume a polyhedral figure. The arsenical odor is rarely perceptible.

2. *Analysis.*

Oxide of lead	53·00
Muriatic acid	2.00
Lime	14·00
Arsenic acid	22·80
Phosphoric acid	8·20

Helvin.

3. It is found at Langbanshytta in Sweden, where it forms narrow veins in a beautiful red, manganesian Pyroxene, and a granular brown Garnet.

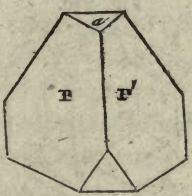
HELIOTROPE. (See *Quartz*.)

HELVIN. Tetrahedral Garnet. MOHS.

Primary form. Tetrahedron.

Secondary form.

Fig. 239.



Cleavage, traces of the octahedron. Fracture uneven. Surface, P smooth, and a little rounded, sometimes streaked parallel to the edges, *a* rough, but even.

Lustre vitreous, inclining to resinous. Color wax-yellow, inclining to honey-yellow, and yellowish brown, or to siskin-green. Streak white. Translucent on the edges.

Hardness = 6·0 ... 6·5. Sp. gr. = 3·100.

1. Before the blow-pipe, upon charcoal, it melts in the reducing flame with effervescence into a globule, of almost the same color as the mineral. In the oxidating flame, the color becomes dark, and the fusion more difficult. With borax, it yields a transparent glass, often colored by manganese.

2. *Analysis.*
By VOGEL.

Silica	39·50
Alumina	15·65
Oxide of iron	37·75
Oxide of manganese	3·75
Lime	0·50

3. It has hitherto been found only at Schwarzenberg in Saxony, in beds in gneiss, accompanied by Blende, Quartz, Fluor and Calcareous Spar.

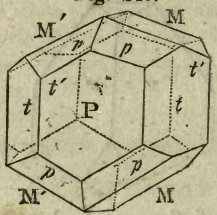
HEMATITE. (See *Limonite* and *Specular Iron.*)

HERDERITE. Prismatic Fluor-Haloide.

Primary form. Right rhombic prism. M on M′ = 115° 53′.

Secondary form.

Fig. 240.



t on *t′*	-	-	-	115°	53′
t on *t*	-	-	-	115	7
p on *p*	-	-	-	141	16

Cleavage distinct parallel to faces M, but interrupted; also perpendicular to the axis,—the latter only in detached portions of very bright and even faces; faint indications parallel to P, *p*. Fracture small conchoidal. Surface, M very smooth, and delicately streaked parallel to its edges of combination with P, and resembling in this respect the faces *p*.

Lustre vitreous, slightly inclining to resinous. Color several shades of yellowish and greenish-white: streak white, strongly translucent.

Very brittle. Hardness = 5·0. Sp. gr. = 2·985.

1. The present species has been confounded with Apatite, which it exceedingly resembles in several properties; but the different aspect of

the faces *p* and *t*, the former being smooth, or but faintly streaked parallel to their intersections with P, while the latter are granulated, proves that the forms do not belong to the hexagonal, but to the prismatic system.

2. The only specimen of Herderite at present known, is in the Wernerian museum at Freiberg. It came from the tin-mines of Ehrenfriedersdorf in Saxony.

HERRERITE. Staphyline Tellurium-Baryte.

Massive: in reniform masses.

Cleavage in three directions, affording rhomboidal fragments, whose angles are incapable of measurement on account of the curvatures of the faces.

Lustre vitreous to pearly, and shining, on fresh surfaces. Color pistachio, emerald, and grass-green. Streak yellowish grey. Translucent.

Brittle. Hardness $=4{\cdot}0 \ldots 4{\cdot}5$. Sp. gr. $=4{\cdot}3$.

1. Before the blow-pipe, on charcoal, it at first becomes grey, and afterwards gives a white smoke, which adheres to the charcoal. On directing the reduction flame of the blow-pipe upon it, it becomes of a beautiful grass-green. Heated in an open tube, it gives an abundant white smoke, which adheres to the glass, and on examining it with a microscope, it is seen to be composed of innumerable white and transparent globules.

2. *Analysis.*

By Herrera.

Carbonic acid	31·86
Tellurium	55·58
Peroxide of nickel	12·32

3. It is found at Albarradon in Mexico, in transition limestone, in a metallic vein, consisting chiefly of ores of lead, Native Silver, Horn-Silver, and Iodic-Silver.

Appendix to Herrerite.

i. *Fibrous Herrerite.* Del Rio.

Massive: reniform, composition columnar, individuals slender and radiating. Earthy and dull.

Color apple green.

Very soft; but brittle. Sp. gr. = 3.

1. It occurs with the above, and would appear to be simply a variety which has suffered partial decomposition.

Herschelite.

Primary form. Regular hexagonal prism.

Secondary form. Primary, having its terminal edges replaced, the new planes inclining to the bases under 132°.

Fracture conchoidal. Surface rough. P dull and curved.

Color, white. Translucent... opake.

Hardness = 4·0 ... 5·5 ? Sp. gr. = 2·11.

1. It is believed to have in general, the composition of Feldspar or Leucite.

2. It is found with Olivin, at Aci Reale in Sicily.

3. It appears to be related to Nephiline; but further researches are required to settle its specific character.

Heterosite. (See *Triplite.*)

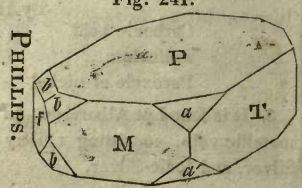
HEULANDITE. Hemi-prismatic Kouphone-Spar. Mohs.

Primary form. Right oblique-angled prism. M on T = 130° 30′.

Secondary form.

M on *a*	-	146°	30′
T on *a*	-	148	00
P on *a*	-	111	56
M on *f*	-	114	20
b on *f*	-	129	40
P on *b*	-	133	35
P on b	-	108	15

Fig. 241.



Cleavage, P highly perfect. Fracture imperfectly conchoidal, uneven. Surface of all the faces more or less uneven; P often concave, M and T convex.

Heulandite.

Lustre vitreous. The faces P possess high degrees of pearly lustre, both as faces of cleavage and of crystallization. Color, various shades of white, prevalent, passing into red, grey, and brown. Streak white. Transparent . . . translucent on the edges.

Brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 2·200. White crystals from Iceland.

Compound Varieties. Massive: composition granular, the individuals being of various sizes, sometimes easily separable, sometimes strongly cohering; faces of composition uneven and rough. Globules formed in vesicular cavities.

1. Before the blow-pipe, it melts with a slight intumescence, during which it emits a phosphoric light.

2. *Analysis.*

	By Laugier. fr. the Tyrol.	By Walmstedt.
Alumina	10·00	7·99
Silica	45·00	59·90
Carbonate of lime	16·00	0·00
Lime	11·00	16·87
Water	12·00	13·43
Oxide of iron	4·00	0·00
Oxide of manganese	0·50	0·00

3. The varieties of Heulandite are usually found accompanied by Stilbite, in the vesicular cavities of amygdaloidal rocks, and in certain metalliferous veins.

4. Iceland and the Faroe islands afford the most magnificent crystals of Heulandite, of a pearly white color, and often transparent. A similar variety comes from the Vendyah mountains in Hindostan. The brick-red crystals and compound masses occur in the Tyrol and in Scotland.

In North America, the present species is found in great perfection in large white crystals, at Cape Blomidon in Nova Scotia. It has also been met with along with Chabasie upon mica slate, at Chester, (Mass.) and with Stilbite and Chabasie on gneiss, at Hadlyme, (Conn.)

Hisingerite.

Massive. Cleavage distinct in only one direction. Fracture earthy.

Hopeite.

Color black. Streak greenish-grey.
Sectile. Soft. Sp. gr. = 3·045.

1. If gently heated before the blow-pipe, it becomes magnetic; in a stronger heat, it melts into a dull, opake, black globule, and yields a yellowish green glass with borax.

2. *Analysis.*

By Berzelius.

Oxide of iron . . .	51·50
Silica . . .	27·50
Alumina . . .	5·50
Oxide of manganese . . .	0·77
Volatile matter . . .	11·75
Magnesia . . .	a trace.

3. It has been found in the parish of Svärta in Südermanland, intermixed with limestone.

4. It is probable that it belongs to the species Limonite.

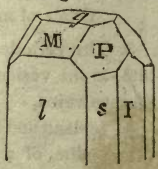
HOPEITE.

Primary form. Right rhombic prism. M on M′ = 101° 24′.

Secondary form.

s on *s* over I - -	81°	34′
M on M over *g* - -	101	24
P on P over M - -	139	41
P on P′ - -	107	2

Fig. 242.



Cleavage parallel with the longer diagonal perfect, that parallel with the base less distinct. Surface, plane I streaked lengthwise; the rest of the faces smooth.

Lustre vitreous, pearly upon *l*. Color greyish white. Streak white. Transparent . . . translucent. Refraction double.

Sectile. Hardness =2·5 . . . 3·0. Sp. gr. =2·76.

1. Before the blow-pipe, it gives off its water, and melts into a clear colorless globule, tinging the flame green. It gives no skeleton of silica with salt of phosphorus, with which it melts in all proportions. If much of the mineral is added, the globule turns opake in cooling, but does not deposit any fumes of zinc on the charcoal. The globule obtained from fusing it with borax does not become opake on cooling. With soda, it gives a scoria which is yellow when hot; copious fumes of zinc, and nearest the scoria, some of cadmium also, are deposited. The melted mineral forms a fine blue glass with solution of cobalt. Hopeite seems therefore to be a compound of some of the stronger acids, as phosphoric, or boracic acid, with zinc an earthy base, a little cadmium, and a great deal of water.

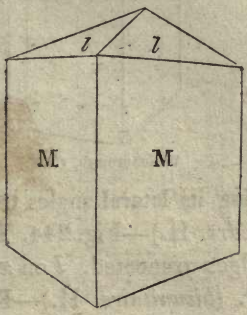
2. It has been hitherto found only in the Calamine mines of Altenberg, near Aix-la-Chapelle, and is very rare.

HORNBLENDE. Hemi-prismatic Augite-Spar. Mohs.

Primary form. Oblique rhombic prism. M on M′= 124° 30′.

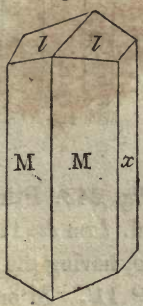
Secondary forms.

Fig. 243.



Edenville, (N.Y.)

Fig. 244.



Edenville and Amity, (N.Y.)

Hornblende.

Fig. 245.

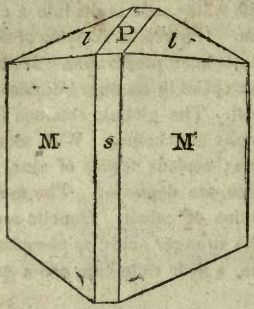
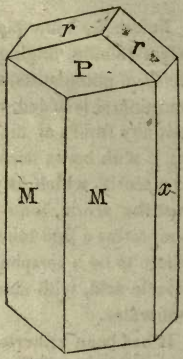
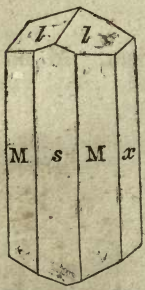


Fig. 246.



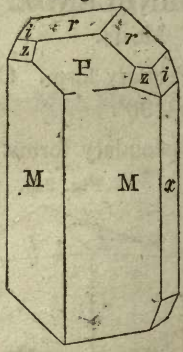
Teplitz, Bohemia.

Fig. 247.



Edenville, (N.Y.)

Fig. 248.



Willsborough, (N.Y.)

Fig. 243. Primary form, having its lateral angles truncated. l on $l = 110° 2'$. (*ditétraèdre.* H.)—Fig. 244. The same, having the acute lateral edges truncated. l on $x = 105° 11'$. M on $x = 117° 43'$. (*bisunitaire.* H.)—Fig. 245. P on $s = 104° 57'$. P on $l = 164° 49'$. M on $s = 152° 17'$. (*dihexaèdre.* H.)—Fig. 246. r on $r = 149°$

38′. r on $x = 105° 11′$. (*dodécaèdre.* H.)—Fig. 247. (*triunitaire.* H.)—Fig. 248. x on $z = 118° 28′$. i on $x = 129° 8′$. (*acceléré.* H.)

Cleavage. M highly perfect; less distinct parallel with P, and to the diagonals of the prism. Fracture imperfectly conchoidal, uneven. Surface, sometimes streaked parallel to the axis; sometimes all the faces are uneven.

Lustre vitreous, inclining to pearly upon faces of cleavage in the varieties possessing pale colors. Color, various shades of green, often inclining to brown; there is an uninterrupted series into perfectly white, and into black varieties. Streak greyish-white . . . brown. Nearly transparent . . . opake.

Brittle. Hardness = 5·0 . . . 6·0. Sp. gr. = 3·167, basaltic Hornblende from Lower Stiria; 3·127, Carinthin; 3·026, Actynolite from Zillerthal; 3·006, blackish-green common Hornblende; 2·931, white Tremolite.

Compound Varieties. Twin-crystals: face of composition parallel, axis of revolution perpendicular to s, of Fig. 245. as in Fig. 250.

Fig. 249.

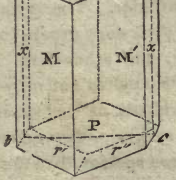
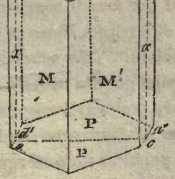


Fig. 250.



This composition is also observable in massive varieties, sometimes in very thin laminæ, having often some foreign

substance, particularly laminæ of Pyroxene, interposed between them. Massive: composition granular, individuals of various sizes, generally strongly cohering, and producing in the large, a tendency to slaty fracture; composition columnar, individuals of various sizes, sometimes very delicate, generally long, parallel, or diverging, and aggregated in a second granular composition. Compositions of short and irregularly distributed columnar particles, possess, in the large, a slaty fracture. Very thin columnar composition produces a silky lustre.

1. Of those varieties of the present species which have obtained distinct names, and which in some systems of mineralogy, have even been regarded as forming separate species, the following are the most remarkable, viz. *Hornblende*, *Tremolite*, *Actynolite* and *Asbestus*. The dark blackish and greenish colors constituted Hornblende, which was divided into *basaltic*, *common* and *slaty*; the first of these affording crystals easily cleavable; the second such as are of difficult cleavage, and the massive, granular and columnar varieties, excepting such as are jet-black, shining and easily cleavable, which were distinguished under the name of *Carinthin*, and the third comprehends such massive specimens as exhibit a slaty fracture. Tremolite consists of the pale green, grey, bluish and white varieties, and has been divided into *common*, *asbestiform* and *granular*. The first occurs in crystals, rarely with perfect terminations, and in massive varieties, in which the individuals are large; the second in columnar compositions, or coarsely fibrous, with considerable degrees of transparency; the third refers to very thin or capillary crystals; and the fourth consists of granular particles. The varieties of Actynolite differ from those of Tremolite, by their deep green, (often grass-green) colors. The asbestiform tremolite, and asbestiform actynolite, form a passage into *asbestus*, which term is applied not only to minute columnar, and variously interwoven individuals of this species, but to those also of Pyroxene and some other species,—the name denoting rather a peculiar state of aggregation in these species, than the substance of a distinct mineral.*

* Asbestus in general, has been divided into *amianthus*, which consists of highly delicate fibres, often thinner than a hair, longitudinally

Hornblende.

Green Diallage or *Smaragdite*, in some cases consists of laminæ of Hornblende, with faces of composition parallel to *s*; in others, of the same, alternating with laminæ of Pyroxene; both generally of bright green colors.

Among the varieties of this species, and those of Pyroxene, a striking analogy of certain varieties has been observed. Augite and Hornblende, Sahlite and Actynolite, Diopside and Tremolite, stand in these relations; and both series terminate in their respective kinds of asbestus.

2. Before the blow-pipe, Hornblende melts with a little difficulty, attended by a slight degree of intumescence, into a globule, which is not clear, but variously colored by iron or chrome, agreeably to the contents of the specimen. In borax, it also fuses slowly.

3. *Analysis.*

	By Bonsdorf.			By Vauquelin.
	a white var.	a green var.	a black var.	Smaragdite, fr. Corsica.
Silica	60.31	46.26	45.69	50.00
Magnesia	24.23	19.03	18.79	6.00
Lime	13.66	13.96	13.85	13.00
Alumina	0.26	11.48	12.18	11.00
Protoxide of iron	0.15	3.43	7.32	0.00
Protoxide of manganese	0.00	9.36	0.22	0.00
Fluoric acid	0.94	1.60	1.50	0.00
Oxide of iron	0.00	0.00	0.00	5.50
Oxide of copper	0.00	0.00	0.00	1.50
Oxide of chrome	0.00	0.00	0.00	7.50
Water & foreign substances	0.10	1.04	0.00	0.00

4. Imbedded crystals of basaltic Hornblende often accompany those of Pyroxene in basaltic and amygdaloidal rocks. Crystals of Hornblende and of Tremolite, are found in limestone and dolomite rocks, as well as in porphyry and granite. Common Hornblende, Actynolite, and Tre-

---

cohering with each other, and easily separated; into *common* asbestus, relating to coarser varieties, more firmly cohering, and yielding splintery fragments; into *Rock-cork*, in which the particles are aggregated in a loose felt-like texture; and into *Rock-wood* or *ligneous asbestus*, in which a texture of the preceding kind, only more firm and close, assumes the appearance of dried wood.

Hornblende.

molite, occur in metalliferous veins and beds in ancient rocks, with ores of titanium, iron, zinc and lead. Common Hornblende frequently enters into the composition of rocks, as in sienite, greenstone, &c. Actynolite is chiefly found in talcose slate. Amianthus lines the sides of narrow veins in primitive mountains.

5. Basaltic Hornblende occurs in beautiful crystals, near Teising and Teplitz in Bohemia. Large and very distinct, black crystals are found imbedded in granular limestone, at Pargas, Finland. Crystals of a handsome green color, often becoming small, and possessed of rounded edges, occur at Pargas in Finland, in white limestone; and which have been called *Pargasite*. The crystals in the drusy cavities of Vesuvian minerals, though small, are generally very distinct, and possess a high degree of lustre. Handsome varieties of Tremolite are found in dolomite at St. Gothard: Amianthus in great abundance at Corsica, also in Piedmont, Savoy, Salzburg, and Zöblitz, in Saxony. Rock-wood exists in large masses, in a metalliferous bed at Sterzing in the Tyrol: Rock-cork at Johanngeorgenstadt in Saxony, at Sahlberg in Sweden, in Moravia, and at the Lead-Hills in Scotland. Green Diallage, generally accompanied by Garnet and Saussurite, occurs at Corsica, on Monte Rosa, in the Bacher, and several other places in Southern Europe.

The United States afford the present species in all its varieties. Long black crystals, sometimes flattened through the truncation of the obtuse lateral edges, occur at Chester, (Mass.) and at Franconia, (N. H.); the latter place likewise affords brilliant black prisms, having the acute lateral edges replaced. Large and handsome black crystals (*dodécaèdre*. H.) occur at Newton, (N.J.) Small but very perfect black crystals, are found at Willsborough, (N.Y.) upon the mountain near the well known Garnet and Tabular Spar locality, where they occur imbedded in black Tourmaline. Very distinct reddish brown crystals, one or two inches long, and possessing nearly the same diameter, have been obtained along with black Spinel, at Amity, (N.Y.) Hair-brown and greenish white crystals, of unusual finish and beauty, occur in the limestone of Edenville, (N.Y.): also a light greyish white variety in limestone, from the same vicinity, associated with yellow Tourmaline and Rutile, whose crystals are often coated and penetrated by Kerolite. White crystals, above an inch long, and three quarters of an inch wide, but much flattened, abound throughout the dolomite beds of Litchfield co. (Conn.) particularly at Canaan; they are also found under similar circumstances, farther north into the borders of Mass achusetts, at Sheffield and Great Bar

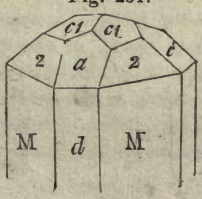
rington. Similar, though more slender forms of the same variety, occur at Antwerp, (N.Y.); at which place also is found the variety Pargasite. Handsome varieties of Actynolite are found at most of the steatite quarries in Vermont; particularly at Windham, Readsborough and New-Fane: also at Middlefield, (Mass.) Massive, granular Hornblende, in large easily cleavable individuals, of a shining black color, are found at Plymouth, (Vt.) and at Edenville, (N.Y.) Columnar and radiating varieties, of the same color, abound in Hawley, (Mass.) A green fibrous variety, the fibres several inches long, and parallel, occurs at Cumberland, (R. I.) Massive Tremolite, as well as fibrous, abounds throughout the granular limestone and dolomite of the country. The finest specimens are found in Litchfield county, (Conn.) Hornblende asbestus abounds at Staten Island, (N.Y.) at West-Farms, (Conn.) at Brighton and Dedham, (Mass.); also near Philadelphia, in Hornblende rocks. A delicate variety, in short fibres, (Byssolite,) occurs in the iron-mines of Franconia, (N. H.)

HORN QUICKSILVER. Pyramidal Pearl-Kerate. Mohs.

Primary form. Right square prism.

Secondary form.

Fig. 251.



M or M on $c1$, or $c1$	-	129° 30?
M or M on $c2$, or $c2$	-	158 00
M or M on d	-	135 00
a on d	-	119 30

Cleavage, parallel with M very indistinct. Fracture perfectly conchoidal. Surface smooth.

Lustre adamantine. Color yellowish grey or ash-grey, also yellowish and greyish white. Streak white. Translucent, sometimes only on the edges.

Sectile. Hardness = 1·0 . . . 2·0. Sp. gr. = 6·482.

Compound Varieties. Crystalline coats, probably formed originally upon globules of fluid mercury: composition not observable. Massive: composition granular.

1. Before the blow-pipe, upon charcoal, it is entirely volatilized, if pure. It is not soluble in water.

2. *Analysis.*

Oxide of mercury	88·48
Muriatic acid	11·52

3. This rare mineral occurs in secondary rocks, along with Cinnabar and ochry varieties of Iron-Ore.

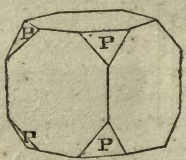
4. Its chief locality is Moschellandsberg in Deuxponts, but it also occurs at Idria in Carniola, and Almaden in Spain. At Horzowitz in Bohemia, it has been found with Cinnabar in veins, traversing a bed of Iron-Ore.

HORN SILVER. Hexahedral Pearl-Kerate. Mohs.

Primary form. Cube.

Secondary forms.

1. Fig. 252.



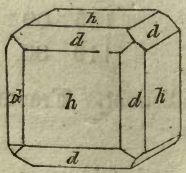
Cornwall, England.

2.

Octahedron.

Siberia.

3. Fig. 253.



Johanngeorgenstadt.

4.

Rhombic dodecahedron.

Siberia.

Horn Silver.

Cleavage none. Fracture more or less perfectly conchoidal. Surface of the cube sometimes faintly streaked parallel to the edges of combination with the dodecahedron.

Lustre resinous, passing into adamantine. Faces of fracture often more splendent than those of crystallization. Color pearl-grey, passing on the one hand into lavender-blue and violet blue, on the other, into greyish, yellowish and greenish white, into sisken-green, asparagus-green, pistachio-green, and leek-green. The color becomes brown on being exposed to light. Streak shining. Translucent . . . feebly translucent on the edges.

Sectile. Hardness = 1·0 . . . 1·5. Sp. gr. = 5·552, a white granular variety from Peru.

Compound Varieties. In crusts: composition scarcely observable, sometimes columnar. Massive: composition granular, strongly coherent, or imperfectly columnar, and often bent; faces of composition rough.

1. It is fusible in the flame of a candle, and emits fumes of muriatic acid. Upon charcoal, it may be almost entirely reduced before the blow-pipe, and is likewise easily reduced, if rubbed wet upon a clean surface of iron or zinc. It is insoluble in nitric acid or in water. It may be obtained in a crystallized state, either from fusion, or from the evaporation of a solution of muriate of silver in ammonia.

2. *Analysis.*

By KLAPROTH.

	from Saxony.	from Peru.
Silver	67·75	76·0
Oxygen	4·75	7·6
Muriatic acid	14·75	16·4
Oxide of iron	6·00	0·0
Alumina	1·75	0·0
Sulphuric acid	0·25	0·0

Horn Silver.

3. Horn Silver is most frequently found in the upper parts of veins in clay slate, but occurs also in beds, generally along with other ores of silver; very often also with ochry varieties of Limonite, or with similar varieties of decomposed Iron-Pyrites. It is associated with several species of copper-ores, and with Calcareous and Heavy Spar.

4. Formerly, it occurred in considerable quantities in the Saxon mining districts of Johanngeorgenstadt and Freiberg; also at Joachimsthal in Bohemia. In small quantities, it occurs in France, in Spain, at Kongsberg in Norway, in Cornwall, and Silesia; but in large masses, frequently associated with Native Silver, in Mexico and Peru, where the green varieties of colors particularly occur.

Hornstone. (See *Quartz.*)

Humboldtine.

Mssive: in plates.
Color bright yellow.
Soft, yielding to the nail. Sp. gr. = 1·3.
Acquires resinous electricity by friction.

1. On ignited charcoal it is decomposed, giving out a vegetable odor, and leaves a metallic stain, at first yellow, then black, and at last red. It is insoluble in water and alcohol.

2. *Analysis.*

By Rivero.

Protoxide of iron - - - - - - -	53·56
Oxalic acid - - - - - - -	46·14

3. It occurs imbedded in moor-coal, near Bilin in Bohemia; and is supposed by Rivero to have been produced from the decomposition of succulent plants.

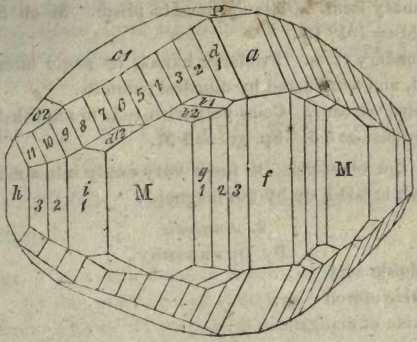
Humboldtite. (See *Datholite.*)

Humite.

Primary form. Right rhombic prism. M on M = 120°.

Humite.

Secondary form. Fig. 254.



P on f or h	. .	90°	00′		h on $d11$	. .	157°	20′
M on h	. .	120	00		h on $g3$	. .	100	40
M on $d1$	. .	118	12		h on $g2$	. .	103	40
M on f	. .	150	00		h on $g1$	. .	115	15
P on $c1$	. .	144	1		h on $i1$	. .	133	36
P on $c2$	. .	153	45		h on $i2$	. .	140	56
h on a	. .	90	00		h on $i3$	. .	143	20
h on $d1$	. .	101	50	Phillips.	$c1$ on $d1$	. .	155	2
h on $d2$	. .	103	42		$c1$ on $d5$	. .	159	10
h on $d3$	. .	112	45		$c1$ on $d7$	. .	159	30
h on $d4$	. .	119	24		$d1$ on $g3$	. .	116	25
h on $d5$	. .	121	45		$d12$ on $d8$	. .	163	22
h on $d6$	. .	125	30		$d12$ on g 3	. .	131	15
h on $d7$	. .	129	46		$b2$ on $g3$	. .	143	15
h on $d8$	. .	121	20		$b1$ on M	. .	137	00
h on $d9$	. .	124	2		f on a	. .	115	10
h on $d10$	. .	136	16					

Cleavage, traces parallel to M and h, or to a six-sided prism.

Fracture imperfectly conchoidal.

Lustre vitreous. Color various shades of yellow, sometimes almost white, passing into reddish brown. Transparent . . . translucent.

Brittle. Hardness = 6·5 . . . 7·0.

1. Alone before the blow-pipe, it becomes opake on the outside, but is infusible. It gives a clear glass with borax.

2. It occurs at Monte Somma, with Mica and various other minerals.

3. Several of the properties of Humite would seem to render it probable that it may be identical with Brucite. At present, however, the crystalline forms of the latter substance oppose this union of the two minerals, although it must be confessed that Brucite has never been found in perfectly formed crystals.

Huraulite.

HURAULITE.

Primary form. Oblique rhombic prism. M on M = 62° 80′. P on M = 101° 13′.

Secondary form. Primary, having its acute lateral edges replaced, and terminated by dihedral summits.

Lustre vitreous. Color yellowish-red, to reddish-brown.

Hardness = 3·5. Sp. gr. = 2·27.

1. Before the blow-pipe, it fuses very easily into a metallic, black globule, which is taken up by the magnet.

2. *Analysis.*

By DUFRESNOY.

Phosphoric acid	38·00
Protoxide of iron	11·10
Protoxide of manganese	32·85
Water	18·00

3. It is found in little masses, dispersed through graphic granite, near Limoges in France, and is accompanied by an olive green, fibrous Vivianite. The graphic granite, however, is not found in place. With the Huraulite is found a massive mineral in scales, fibres, and impalpable, which is supposed to be the same substance. The scaly variety is of an intense, reddish-brown color, and a bright pearly lustre.

HYACINTH. (See *Zircon.*)

HYALITE. (See *Opal.*)

HYALOSIDERITE.

A partially decomposed variety of Peridot.

HYDRATE OF MAGNESIA. (See *Native Magnesia.*)

HYDRARGILLITE. (See *Wavellite.*)

HYDRO-CARBON.

Primary form unknown. Crystals acicular.

Lustre pearly. Color white, or yellowish-white.

Sp. gr. = 0.65.

HYDRO-CARBONATE OF LIME.

The variety Chalk of Calcareous Spar, altered by having been subjected to the influence of trap dykes. It occurs at the Giant's Causeway in the north of Ireland. According to DA COSTA, it consists of four atoms of carbonate of lime, and three atoms of water.

HYDRO-CARBONATE OF LIME AND MAGNESIA.

A variety of Calcareous Spar or Dolomite, found in veins and irregular masses, in an amygdaloid of a loose texture, accompanied by zeolitic minerals and the common Calcareous Spar, at Derry in the north of Ireland.

HYDROGEN. Pure Hydrogen-Gas. MOHS.

Amorphous. Transparent. Expansible.

Sp. gr. = 0·0688. BERZ. 0·0732. BIOT and ARAGO.

Odor peculiar.

1. Hydrogen-Gas, as it is found in nature, is generally in a state of combination. By the assistance of chemical processes, it may be obtained, free from all odor. It burns with a feeble light in atmospheric air, and if mixed with it, detonates when inflamed. It imparts neither taste nor odor to water, with which it is kept in contact.

2. Hydrogen-Gas is developed from several kinds of rocks, limestone, beds of coal, &c.; also from pools and stagnant water in general; and it is met with under these circumstances in different countries throughout the globe.

HYDROLITE. (See *Gmelinite.*)

HYDROPHANE. (See *Opal.*)

HYDROPHYLLITE. (See *Appendix.*)

HYDROSILICITE. (See *Kerolite.*)

HYPERSTHENE. Prismatoidal Schiller-Spar. MOHS.

Primary form. Obliqne rhombic prism. M on M = about 93°.

Secondary form. Primary, having the acute lateral edges bevelled. Warwick, (N.Y.)

Cleavage, parallel to the sides and base of the primary prism, more perfectly, parallel to the shorter diagonal of that form, traces parallel to the longer diagonal of the same. Fracture uneven.

Hypersthene.

Lustre eminently metallic-pearly, upon the most perfect diagonal cleavage; in other directions, more or less distinctly vitreous. Color greyish, brownish or greenish-black; several varieties almost copper-red upon the perfect face of cleavage. Streak greenish-grey. Opake; in some varieties, slightly translucent on the edges.

Brittle. Hardness $=6{\cdot}0$. Sp. gr. $=3{\cdot}389$.

Compound Varieties. Massive: composition granular, individuals sometimes of considerable size; faces of composition uneven and rough.

1. If heated alone, it is little altered in appearance, but melts upon charcoal into a greenish-grey, opake globule, easily soluble in borax.

2. *Analysis.*

By KLAPROTH.

Silica	54·25
Magnesia	14·00
Alumina	2·25
Lime	1·50
Oxide of iron	24·50
Water	1.00
Manganese	a trace.

3. Hypersthene occurs engaged in a mixture of Labradorite and Pyroxene. The rock often contains Magnetic Iron-Ore, and seems to be analogous to sienite or greenstone. It exists also in a slaty rock with Garnet, in serpentine along with Saussurite, and in white limestone along with Spinel and Brucite.

4. It was first brought from the coast of Labrador. It is quoted from Cornwall, England, where it is said to occur in serpentine, and from Greenland, where it exists in primitive slate. The variety, however, from the last mentioned place, with a blue opalescence parallel to the shorter diagonal of the prism, presents two faces of cleavage inclined at an angle of about 124° 30′, and must be referred to the species Hornblende.

Hypersthene has within a few years been met with in Orange county, (N.Y.) at Warwick, in the formation of limestone, with which is associated serpentine, and which is so abundant in Spinel and Brucite. It oc-

curs here in crystals several inches long, by half an inch in diameter; but oftener in very minute prisms. In both cases, the prisms are deficient in regular, terminating planes, though they commonly have their acute lateral edges bevelled. It is associated with Brucite, and is not abundant.

HYPOCHLORITE. (See *Green Iron-Ore.*)

HYPOSKLERITE. (See *Feldspar.*)

HYPOSTILBITE.

Massive: in globules, consisting of delicate fibres, or impalpable.

Lustre feeble. Color white.

Does not scratch glass. Sp. gr. = 2·14.

1. Before the blow-pipe, it melts with difficulty upon the edges; the mass swelling and becoming rough. Soluble in the acids without forming a jelly. The solution furnishing a precipitate by oxalate of ammonia.

2. *Analysis.*

	By BEUDANT.	By DU MENIL.
Silica	54·43	52·25
Alumina	18·32	18·75
Lime	8·10	7·36
Soda	2·41	2·39
Water	18·70	18·75

3. It has been found with Stilbite and Epistilbite, in amygdaloid, from Faroe.

4. The above description is quite inadequate for the distinction of this mineral from Mesotype.

ICE-SPAR. (See FELDSPAR.)

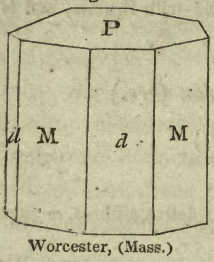
IDOCRASE. Pyramidal Garnet. MOHS.

Primary form. Right square prism.

Idocrase.

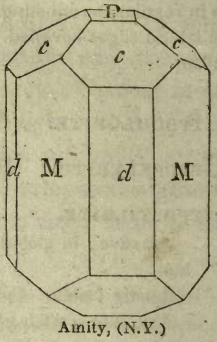
Secondary forms.

Fig. 255.



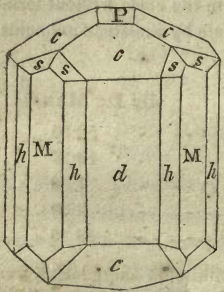
Worcester, (Mass.)

Fig. 256.



Amity, (N.Y.)

Fig. 257.



Vesuvius. Norway.

Fig. 258.

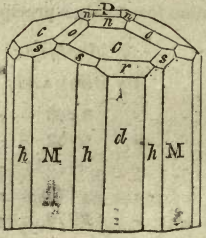
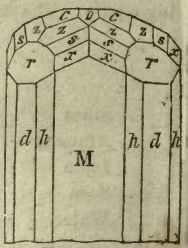


Fig. 259.



Vesuvius.

Fig. 255. Primary form, with the lateral edges truncated. M on $d=135°$. (*périoctaèdre*. H.)—Fig. 256. The same, having the terminal edges truncated. P on $c=142°\ 54'$. (*unibinaire*. H.)—Fig. 257. M on $h=153°\ 27'$. d on $h=161°\ 33'$. s on $s=148°\ 24'$. c on $s=150°\ 31'$. M on $s=144°\ 44'$. (*isoméride*. H.)—Fig. 258. P on $n=165°\ 51'$. c on $r=145°\ 25'$. d on $r=161°\ 42'$. r on $s=152°\ 58'$. P on $o=151°\ 52'$. c on $o=154°\ 45'$. M on o

$=118° 8'$. (*encadrée.* H.)—Fig. 259. P on $r=108° 18'$. d on $r=161° 42'$. r on $z=153° 30'$. r on $s=152° 58'$. r on $x=150° 35'$. x on $x=154° 28'$. z on $z=139° 52'$. (*ennéacontaèdre.* H.)

Cleavage, parallel with M not very distinct, still less so parallel with P. Fracture imperfectly conchoidal, uneven. Surface, P sometimes uneven and curved; the lateral faces striated parallel to their common intersections, the rest of the faces smooth.

Lustre vitreous, inclining to resinous, sometimes the latter very distinctly. Color various shades of brown, passing into leek-green, pistachio-green, olive-green and oil-green. Streak white. Semi-transparent... faintly translucent on the edges. If viewed in the direction of the axis, the colors incline more to yellow, perpendicular to it, more to green.

Hardness $=6·5$. Sp. gr.$=3·399$.

Compound Varieties. Massive: composition granular, of various sizes, sometimes considerable, and often strongly connected. There occur also columnar compositions, generally of thin individuals, straight and divergent or irregular, faces of composition irregularly streaked.

1. Before the blow-pipe, on charcoal, it melts easily into a pale green glass, rarely attended by effervescence. With borax, it easily melts into a clear glass stained with iron.

2. *Analysis.*

	By Klaproth.		By Borkowsky.
	fr. Vesuvius.	fr. Silesia.	fr. Eger, Bohemia.
Silica	35·50	42·00	41·00
Alumina	33·00	16·25	22·00
Lime	22·25	34·00	22·00
Magnesia	0 00	0·00	3·00
Oxide of iron	7·50	5·50	6·00
Oxide of manganese	0·25	a trace.	2·00
Potash	0·00	0·00	1·00

3. Some of the varieties of Idocrase occur in serpentine, others in veins in gneiss and limestone, and in ejected volcanic masses. It is commonly associated with Garnet, Pyroxene, Mica and Hornblende.

4. The imbedded crystals of the form *unibinaire*, have been found on the banks of the Wilui river, and Lake Baikal in Siberia; the implanted, complicated crystals occur at Monte Somma, among the fragments ejected by Vesuvius, and have been originally formed in those cavities of the rock in which they are found. At Hasta, near Eger in Bohemia, it occurs in long, reddish-brown, deeply striated forms, and in columnar masses; in similar circumstances in Finland. In beds in limestone, it occurs at Orawitza in the Bannat of Temeswar, and at Mount Monzoni near Fassa in Tyrol; also near Christiania in Norway, and in magnificent crystals of a light green color, in the valley of Brozzo, and at other places in Piedmont. A variety from Tellemarken in Norway, of a blue color, and containing copper, has been called *Cyprine*.

The most interesting specimens of Idocrase which the U. S. has hitherto afforded, were discovered at Worcester, (Mass.) in a quartzose rock, in which it formed seams and veins, accompanied by Pyroxene and Garnet. The variety is precisely similar to that from near Eger in Bohemia. Another locality is at Amity, (N.Y.) where it occurs both granular and in crystals, (sometimes an inch in diameter,) disseminated through limestone with Pyroxene and Hornblende. The granular variety was supposed by Dr. THOMSON to constitute a new species, to which he gave the name of *Xanthite*. The handsome brown crystals accompanying Corundum at Newton, (N. J.) have been erroneously referred to this species: they belong to Tourmaline.

IGLOITE. (See *Arragonite*.)

ILMENITE. (See *Crichtonite*.)

ILVAITE. (See *Yenite*.)

INDIANITE.

Massive; composition granular to impalpable. It yields to cleavage, according to BROOKE, in two directions, inclined to each other under angles of 95° 15′ and 84° 45′.

Lustre vitreous. Color greyish-white, with a tinge of rose-red. Translucent.

Iodic Silver.

Hardness = 5·5 . . . 6·0. Sp. gr. = 2·72.

1. It is infusible before the blow-pipe.

2. *Analysis.*

	By Chenevix.	By Laugier.	
		white variety.	rose-red variety.
Silica	42·5	43.0	42·0
Alumina	37·5	34·5	34·0
Lime	15·0	15·6	15·0
Soda	0·0	2·6	3·3
Oxide of iron	3·0	1·0	3·2
Water	0·0	1·0	1·0

3. It occurs in the Carnatic, associated with Feldspar, Hornblende, Garnet, Corundum, Epidote and Magnetic-Iron.

4. It is nearly related to, if not identical with, Labradorite.

Indicolite. (See *Tourmaline.*)

Iodic Mercury.

In spots of a fine lemon-yellow color, in the variegated sandstone of Casas viegas, Mexico. In the air, as well as in ammonia, it changes to black. It resembles the artificial protiodide of mercury.

IODIC SILVER. Monotomous Pearl-Kerate.

Massive: in thin plates.

Color greyish white, or silver-white. Exposed to the air, it changes to lavender-blue. Lustre resinous. Streak semi-metallic. Translucent.

Soft, flexible.

1. Before the blow-pipe, on charcoal, it instantly melts, and produces a smoke which tinges the flame of a beautiful violet color, globules of silver at the same time appearing upon the charcoal.

2. It is found at Albarradon, near Mazapil in Mexico, and occurs in thin veins in steatite.

IOLITE. Prismatic Quartz. Mohs.

Primary form. Regular hexagonal prism.

Secondary forms.

1. Primary, having the terminal edges truncated.

2. The same, having all its edges, both lateral and terminal, truncated; rarely, also, its angles.

Cleavage, parallel with M, but very indistinct. Fracture conchoidal. Surface of some crystals rough and dull.

Lustre vitreous. Color various shades of blue, generally inclining to black. Streak white. Transparent... translucent; blue if viewed in the direction of the axis, yellowish-grey if perpendicular to it.

Hardness =7·0...7·5. Sp. gr. =2·583...2·718.

Compound Varieties. Massive; composition granular, strongly connected, and recognized with difficulty.

1. Before the blow-pipe, it melts in a good heat, but with difficulty, and only on its edges, into a glass not inferior to the mineral, either in color or transparency.

2. *Analysis.*

	By Gmelin.	By Stromeyer.	By Dr. Brandes. var. Peliom, fr. Bavaria.	By Bonsdorff. var. Steinheilite, fr. Finland.
Silica	42·60	48·538	54·00	49·95
Alumina	34·40	31·730	28·50	32·28
Magnesia	5·80	11·305	0·50	10·45
Lime	1·70	0·000	0·00	0·00
Oxide of iron	1·50	5·686	16·18 peroxide	5·00
Ox. manganese	1·70	0·702	0·25	0·03

3. Iolite occurs in aggregated crystals with Garnet, Quartz, &c. at Cabo de Gata in Spain, in the bay of San Pedro; and this variety has been called *Iolite*. *Peliom* is found at Bodenmais in Bavaria, sometimes in very distinct crystals, but generally massive, with Magnetic Iron-Pyrites. It occurs with Feldspar and Garnet, in fine crystals, at Ujordlersoak in Greenland, at Arendal in Norway, and at Orijerfvi in Finland:

the variety from the last place has been called *Steinheilite*. Iolite also comes from Siberia and from Lunzenau in the Erzgebirge.

It is found in the U. S. at Haddam in Connecticut, associated with Garnet and Anthophyllite in gneiss.

4. The *Saphire d'eau* of the jewellers is a transparent variety of the present species from Ceylon.

IRIDOSMINE. Iridosmic Sclerone-Metal.

Primary form. Regular hexagonal prism.

Cleavage indistinct, and only in the direction of the bases.

In grains.

Lustre metallic. Color between silver-white and lead-grey.

Malleable with difficulty. Hardness = 6·5. Sp. gr. = 17·96 ... 18·57.

1. It undergoes no perceptible change when heated before the blow-pipe. Heated with nitre, it affords the characteristic odor of osmium and a mass soluble in water, to which, when nitric acid is added, a green precipitate makes its appearance.

2. *Analysis.*

By THOMSON.

Osmium	24·5
Iridium	72·9
Iron	2·6

3. It is found with Native Platina, at Nijnotaguilsk, in the Urals, and in South America.

IRON PYRITES. Hexahedral Iron-Pyrites. MOHS.

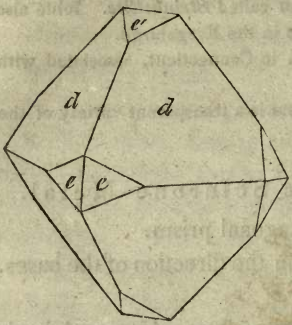
Primary form. Cube.

Secondary forms.

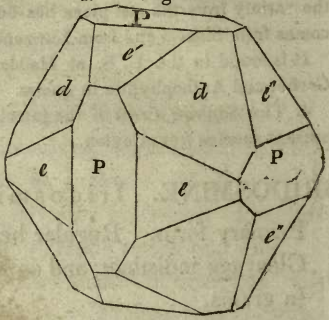
1.	2.
Cube, with angles truncated.	Regular octahedron.
Shoreham, (Vt.) Marietta, (Ohio.)	Haddam, (Conn.) Rare.

Iron Pyrites.

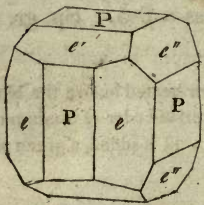
3. Fig. 260.



4. Fig. 261.

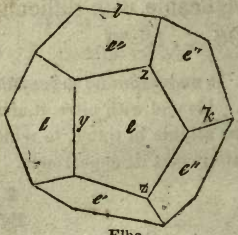


5. Fig. 262.



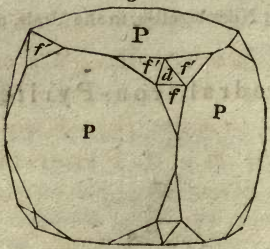
Cornwall—Elba.

6. Fig. 263.

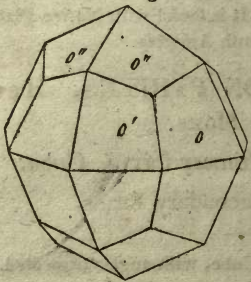


Elba.

7. Fig. 264.



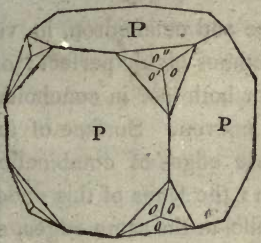
8. Fig. 265.



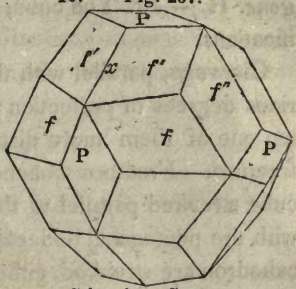
Corsica.

Iron Pyrites.

9. Fig. 266.

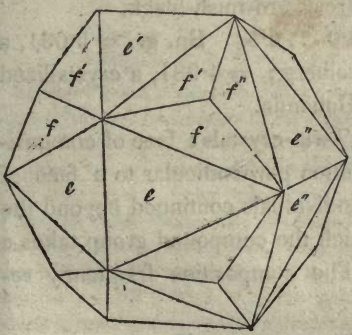


10. Fig. 267.



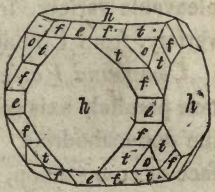
Schneeberg, Saxony.

11. Fig. 268.



Elba.

12. Fig. 269.



Valley of Planen, near Dresden.

1. (*Cubo-octaèdre.* H.)—2. (*octaèdre.* H.)—3. *e* on *e* 126° 52′ 12″. *d* on *e* = 140° 46′ 7″. (*icosaèdre.* H.)—4. P on *e*=153° 26′ 5″. (*cubo-icosaèdre.* H.)—5. (*cubo-dodecaèdre.* H.)—6. (*dodecaèdre.* H.)—7. P on *o*=144° 44′ 8″. *o* on *o*=131° 48′ 36″. (*triépointé.* H.)—8. (*trapezoidal.* H.)—9. *f* on *f*=141° 47′ 12″. *d* on *f*=157° 47′ 33″. P on *d*=152° 15′ 52″. (*quadriépointé.* H.)—10. (*triacontaèdre.* H.)—11. *f* on *e* =162° 58′ 34″. (*panto-*

gène. H.)—12. The cube, embracing all the previous modifications.

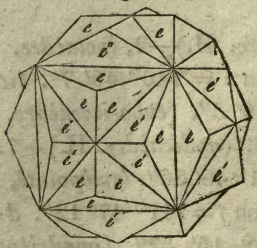
Cleavage, parallel with the cube and octahedron, in various degrees of perfection; sometimes highly perfect; often one of them more distinct, or both lost in conchoidal fracture. Fracture conchoidal, uneven. Surface of the cube streaked parallel to the obtuse edges of combination with the pentagonal dodecahedron: the faces of this dodecahedron are streaked, either parallel to the same edges, or parallel to edges which are perpendicular to the former.

Lustre metallic. Color, very few shades of a characteristic bronze-yellow. Streak brownish-black.

Brittle. Hardness = 6·0 ... 6·5. Sp. gr. = 5·031, a cleavable variety, from Freiberg; = 4·981, a crystallized variety, from Littmittz in Bohemia.

Compound Varieties. Twin-crystals: face of composition parallel, axis of revolution perpendicular to a face of the dodecahedron. The individuals continued beyond the face of composition, by which the compound group takes a cruciform appearance. The composition frequently repeated.

Fig. 270.



Schoharie, (N.Y.)

Iron Pyrites.

Imbedded and implanted globules; surface drusy; composition indistinctly columnar. Massive; composition granular, sometimes even impalpable, strongly coherent; fracture uneven, or on a large scale, flat conchoidal. Cellular.

1. In the oxidating flame of the blow-pipe, Iron Pyrites becomes red upon charcoal, the sulphur is expelled, and oxide of iron remains. At a high temperature, in the interior flame, it melts into a globule, which continues red-hot for a short time when removed from the blast, and possesses, after cooling, a crystalline fracture and metallic appearance. In heated nitric acid, it is partly soluble, and leaves a whitish residue. Some varieties are subject to decomposition when exposed to the action of the atmosphere.

2. *Analysis.*

By HATCHETT.

Iron	47·30	-	-	47·85
Sulphur	52·70	-	-	52·15

3. Iron-Pyrites is one of the most common and widely diffused species among the ores; and occurs in very various repositories. It is engaged in imbedded crystals, and in massive nodules; the former particularly in clay-slate and greywacke-slate, the latter in greenstone, granular limestone, &c. It even forms beds by itself, included in primitive slate; and is often an important ingredient of those beds which contain ores of lead, iron, &c. It frequently occurs mixed with coal seams, and the beds of clay which form a part of the coal measures. The *Auriferous Pyrites* contains a small portion of native gold mechanically mixed with it, which appears to operate by a galvanic effect in producing the decomposition to which this variety is so generally subject. Iron-Pyrites is also found with ores of silver. It is contained in many organic remains, both of vegetable and animal origin, and is one of the species which can be distinctly traced in the composition of some of the meteoric masses.

4. Some of the crystals, along with their localities, have been mentioned above. The island of Elba is the most conspicuous for large and well defined crystals: very fine crystals are found in Piedmont, at Freiberg, Johanngeorgenstadt, &c. in Saxony, in Bohemia, in Hungary, in the Hartz, at Kongsberg in Norway, at Fahlun in Sweden, in Derbyshire and Cornwall.

The United States is not particularly rich in localities of interesting varieties of Iron-Pyrites. Shoreham, (Vt.) and Schoharie, (N. Y.) pro-

duce, in the black limestone quarry of the former place, and in the water limerock of the latter, the handsomest crystals we have yet discovered. The secondary limestones in the vicinity of Marietta, (Ohio,) afford interesting crystals.

5. Iron-Pyrites is roasted for extracting sulphur; after which it is exposed to the oxidating influence of the air for the production of sulphate of iron.

Iron Sinter.

Reniform, stalactitic ... massive. Composition impalpable. Fracture conchoidal.

Lustre vitreous. Color yellowish-, reddish-, blackish-brown. Transparent ... translucent on the edges.

Not very brittle. Soft. Sp. gr. = 2·40.

1. Before the blow-pipe, it intumesces, and some varieties emit a strong arsenical odor, during which they are partly volatilized.

2. *Analysis.*

	By Klaproth.	By Kersten, fr. Freiberg.	By Stromeyer.
Oxide of iron	67·00	40·45	33.46
Arsenic acid	0·00	30·25	26·06
Sulphuric acid	8·00	0·00	10·75
Protoxide of manganese	0·00	0·00	0·59
Water	25·00	28·50	28·48

3. It is found in several old mines, as Freiberg and Schneeberg in Saxony, and in Upper Silesia.

Iserine.

In small rounded grains.

Cleavage scarcely distinguishable. Fracture conchoidal.

Lustre semi-metallic. Color black. Streak black.

Hardness = 5·5. Sp. gr. = 4·68 ... 4·78.

1. Before the blow-pipe, alone, on charcoal, it is unalterable. With the fluxes, it acts in general like Magnetic-Iron; but with the salt of phosphorus, it presents in the reduction flame a bluish-red color.

2. *Analysis.*

	By Rose, fr. Norway.	fr. Iserwerse.	By Klaproth, fr. Cornwall.	By Berthier, fr. Brazil.
Titanic acid	43·73	50·12	45·25	43·5
Peroxide of iron	42·70	49·88	51·00	54·0
Protoxide of iron	13·57			
Oxide of manganese	0 00	0·00	0·25	0·0
Silica	0·00	0·00	3·50	2·50

3. Its localities are numerous; the principal ones, however, are the banks of the Mersey near Liverpool, England, and Iserweise in the Riesengebirge.

4. Iserine possesses a strong affinity to Crichtonite in its most important properties, with which it is probable that future researches will prove it identical.

ISOPYRE.

Regular forms not observed. Massive, in very pure masses of considerable size, (nearly two inches in each direction): composition impalpable. Fracture conchoidal.

Lustre vitreous, often considerable. Color greyish black and velvet, occasionally dotted with red. Streak pale greenish grey. Opake, or very faintly translucent on the thinnest edges, with a dark, liver brown tint.

Brittle. Hardness = 5·5 . . . 6·0 Sp. gr. = 2·91.

Slight action on the magnetic needle.

1. From the description of Tachylite, (by BREITHAUPT,) it would seem that Isopyre is identical with that substance, excepting that the sp. gr. of Tachylite is only 2 5 . . . 2·54.

2. Before the blow-pipe, it fuses without the disengagement of moisture or gas; melted in salt of phosphorus, it gives indications of silica.

2. *Analysis.*
By TURNER.

Silica	47·09
Alumina	13·91
Peroxide of iron	20·07
Lime	15·43
Peroxide of copper	1·94

4. Isopyre is found in the west of Cornwall.

ITTNERITE. (See *Sodalite.*)

JADE. (See *Nephrite.*)

JAMESONITE. Axotomous Antimony-Glance. MOHS.

Primary form. Right rhombic prism. M on M = 101° 20′.

Secondary forms. The primary, with its acute lateral edges truncated.

Cleavage, parallel with T highly perfect; less distinct, though easily observed, when the crystals are not too small, parallel with M and the secondary lateral planes. Fracture not observable.

Lustre metallic. Color steel-grey. Streak unchanged. Sectile. Hardness $=2{\cdot}0 \ldots 2{\cdot}5$. Sp. gr. $= 5{\cdot}564$.

Compound Varieties. Massive: composition columnar, individuals generally very delicate; straight and parallel, or divergent.

1. Before the blow-pipe, in an open tube, it yields a dense white smoke of oxide of antimony, and leaves behind chiefly antimoniate of lead. Upon charcoal, after the volatilization of the antimony and lead, there remains behind a slag, which, with the fluxes, exhibits the reaction of oxide of iron, containing traces of oxide of copper.

2. *Analysis.*

By Rose.

Sulphur	22·15	22·53
Lead	40·75	30·71
Copper	0·13	0·19
Iron	2·30	2·65
Antimony	34·40	34·90

3. It occurs in masses of considerable dimensions in Cornwall; also in Hungary.

Jeffersonite. (See *Pyroxene.*)

JOHANNITE. Cyprine Uranium-Salt.

Primary form. Oblique rhombic prism. M on M $=$ 111°?

Cleavage, parallel with M.

Color grass-green, to siskin-green. Lustre vitreous. Streak siskin-green. Semi-transparent.

Hardness $=2{\cdot}0 \ldots 2{\cdot}5$. Sp. gr. $= 3{\cdot}1 \ldots 3{\cdot}2$. Taste bitter, rather than astringent.

1. It dissolves easily in water; and is a double sulphate of uranium and copper, containing water.

2. It is very rare, and has been met with only in an abandoned mine at Joachimsthal in Bohemia.

JURINITE. (See *Brookite.*)

KAKOCHLOR.

In imitative shapes, and compact. Fracture conchoidal, to uneven.

Lustre resinous. Color bluish black.

Hardness = 2·5 . . . 3·0.

1. Locality not mentioned.

KAKOXENE.

In capillary crystals, and massive, with fine columnar composition, consisting of divergent individuals.

Lustre silky. Color yellowish, to brown. Streak yellowish.

Hardness = 3·00 . . . 4·00. Sp. gr. = 3·38.

1. *Analysis.*

By STEINMANN.

Phosphoric acid	17·86
Alumina	10·01
Silica	8·90
Peroxide of iron	36·82
Lime	0·15
Water and fluoric acid	25·95

2. It is found in the fissures of a variety of Limonite, in the mines of Hrbek, near Zbirow in Bohemia.

3. It is altogether probable that this mineral is only a variety of Wavellite.

KAOLIN.

Decomposed Feldspar and Albite. q. v.

KARPHOLITE. Prismatoidal Wavelline-Spar.

Massive: composition thin columnar, scopiform and stellular, rather incoherent, meeting again in angularly granular compositions.

Lustre silky. Color high straw-yellow, sometimes approaching to wax-yellow. Opake.

Hardness = 4·5 ... 5·5. Sp. gr. = 2·935.

1. It intumesces before the blow-pipe, becomes white, and melts imperfectly into a coherent mass.

2. *Analysis.*

	By Steinmann.	By Stromeyer.
Silica	37·53	36·154
Alumina	26·48	28·669
Protoxide of manganese	17·09	19·160
Protoxide of iron	5·64	2·290
Lime	0·00	0·271
Fluoric acid	0·00	0·470
Water	11·36	10·780

3. It occurs in granite at Schlackenwald in Bohemia, accompanied by Fluor and Quartz.

KARPHOSIDERITE.

Reniform masses; rarely, also, granular. Fracture uneven.

Lustre resinous; shining and glimmering in the streak. Color straw-yellow.

Hardness = 4·0 ... 4·5. Feels greasy. Sp. gr. = 2·5·

1. Before the blow-pipe, upon charcoal, it becomes black; and melts, in a strong fire, into a globule, which is attractable by the magnet. In glass of borax, it is easily soluble; and with salt of phosphorus, it melts into a black scoria. It contains oxide of iron, phosphoric acid, water, with small quantities of oxide of manganese and zinc.

2. It occurs in Greenland.

KARSTENITE. (See *Anhydrite*.)

KERASITE. Peritomous Lead-Baryte. HAIDINGER.

In radiated masses.

Cleavage highly perfect and easily obtained, parallel to a right rhombic prism of 102° 27′, and in the direction of its shorter diagonal. Fracture imperfectly conchoidal, to uneven.

Lustre adamantine, particularly upon the cross-fracture, inclining to pearly upon faces of cleavage. Color yellowish white, straw yellow, rose red, pale. Translucent. Brittle. Hardness =2·5 . . . 3·0. Sp. gr. =7·077.

1. It decrepitates slightly before the blow-pipe, and is easily melted; the globule is of a deeper color than the mineral. On charcoal, it is reduced, and emits fumes of muriatic acid. Treated with peroxide of copper and salt of phosphorus, the flame assumes an intensely blue color.

2. *Analysis.*

By Berzelius.

Oxide of lead	90·13
Muriatic acid	6·84
Carbonic acid	1·03
Water	0·54

3. It is found near Church-hill, in the Mendip Hills in Somersetshire, engaged in manganese-ores, and accompanied by several other salts of lead, and by Calcareous Spar.

Keratite. (See *Quartz.*)

Keratophyllite. (See *Hornblende.*)

KEROLITE. Brittle Atelene-Picrosmine.

Primary form. Doubly oblique prism. Dimensions unknown.

Cleavage, parallel with M highly perfect, and easily obtained; less distinct parallel with T, least of all parallel with P. Fracture uneven. Surface of M streaked parallel with its combinations with P.

Lustre pearly upon M, inclining to vitreous; upon the rest, glimmering or dull. Color oil-green, siskin-green, leek-green, to blackish green, rarely presenting patches of duck-blue. Streak white. Translucent, in thin laminæ.

Sectile. Laminæ brittle. Hardness=2·5 . . . 3·0. The lowest degrees upon M: the highest upon the solid angles and edges. Sp. gr. =2·4 . . . 2·6.

Kerolite.

Compound Varieties. Massive: composition broad columnar, curved, lamellar and divergent: also botryoidal in cavities, and impalpable. Sp. gr. of the compact =2·2... 2·3. Color white, tinged by grey, green and red.

1. Before the blow-pipe, when heated suddenly, it decrepitates violently; the fragments becoming white and harder. In very small fragments, if the heat is gradually applied, a roundish enamel-like edge is produced; but unattended with any ebullition. In powder, with borax, the lighter colored varieties produce a perfectly colorless glass; the blackish green variety affords a greenish transparent glass. Pseudomorphoses in the shape of Quartz, Hornblende and Spinel.

2. *Analysis.*

	By Pfaff.	By Nuttall.	By Steel.	By Shepard.	
	var. Kerolite.	var. Marmolite, fr. Hoboken.		var. Deweylite. fr. Middlefield.	bl. gr. var. fr. Blanford.
Magnesia	18.01	46·0	41·720	40·00	41·400
Silica	37·95	36·0	41·256	40·00	40·00
Lime	0·00	2·0	0·000	0·00	0·932
Water	31·00	15·0	17·680	20·00	15·670
Protox. iron, with traces of chrome	0·00	0·5	0·000	0·00	2·700
Alumina	12·18	0·0	1·000	0·00	0·000
Peroxide of iron	0·00	0·0	0·400	0·00	0·000

3. The present species is found in veins in serpentine, and disseminated through Schiller-Spar.

4. The Kerolite was first described by Breithaupt, as occurring in reniform masses, in plates and compact, with a hardness = 2·0... 2·5, and sp. gr. = 2·33... 2·4, having a resinous lustre, and occurring in thin seams in serpentine, at Franckenstein in Silesia. The *Marmolite* of Nuttall must be referred to the same species; it occurs at Hoboken, (N. J.) where it is found forming narrow veins in serpentine; and from whence is derived the specimens possessed of a distinctly crystalline structure. It also occurs at this place possessed of an impalpable texture, but only in small quantities. A leek green and blackish green, variety, in curved and stellular laminæ, occurs at Blandford, (Mass.) engaged in Schiller-Spar. The compact variety of the United States, and which has been called *Deweylite*, by Emmons, is found in seams and irregular veins at Middlefield, (Mass.) at Cooptown, Hartford county,

(Md.) and at Amity, (N. Y.) The pseudomorphoses occur at Middlefield, (Mass.) in the shape of Quartz, of considerable dimensions, and of greyish white color; and at Amity, (N. Y.) of a bluish green and dark green color, in the shapes of Hornblende and Spinel.

Appendix to Kerolite.

i. *Dermatin.* Breithaupt.

Reniform, rarely globular, and in thin coatings or crusts. Fracture conchoidal.

Lustre resinous, slightly increased in the streak. Color blackish-green to leek-green, dark olive-green, and dark liver-brown. Translucent on the edges. Streak straw-yellow, or pea-yellow.

Hardness = 2·0. Sp. gr. = 2·136.

1. It has a greasy feel, and when moistened by the breath, emits an earthy smell. Before the blow-pipe, it cracks, changes to a black color, and increases in hardness.

2. It is found upon serpentine, at Waldheim in Saxony.

Killinite. (See *Spodumene.*)

Knebelite.

Massive. Fracture imperfectly conchoidal.

Lustre glistening, to dull. Color grey, spotted dirty white, red, brown and green. Opake.

Hard. Difficult to break. Sp. gr. = 3·714.

1. Alone, before the blow-pipe, it remains unaltered.

2. *Analysis.*

By Doebereiner.

Silica	32·5		30·32
Protoxide of iron	32·0		34·58
Protoxide of manganese	35·0		35·10

Locality unknown.

Konigite.

Primary form. Right rhombic prism. M on M′ = 105°.

Crystals elongated, somewhat barrel-shaped, and closely aggregated.

Cleavage parallel with P, perfect.

Color emerald and blackish-green. Translucent.

Hardness = about 2·0.

Kupaphrite.

1. It consists of sulphuric acid and oxide of copper.

2. It accompanies Red Copper-Ore, and comes from Werchetori in Siberia.

3. In chemical composition it resembles Brochantite, but this substance occurs in thin rectangular tables, whose angles are truncated, and edges bevelled, without any traces of cleavage.

Kornite.

An impalpable variety of Quartz, (q. v.) of a dull green color, a feebly vitreous lustre, and conchoidal, or splintery fracture: with sp. gr. = 2·8 ... 2·9. It is also called *Splintery Hornstone.*

Koupholite. (See *Prehnite.*)

Krokalite. (See *Mesotype.*)

Krokydolite.

Massive: composition columnar, particles of composition thin and parallel; impalpable, when the fracture is uneven or splintery.

Color indigo-blue.

Hardness = about 4·0. Sp. gr. = 3·200 ... 3·265.

1. Before the blow-pipe, it easily melts into a shining black glass, which is magnetic.

2. *Analysis.*

By Stromeyer.

	Fibrous variety.	Compact variety.
Silica	50·81	51·64
Protoxide of iron	33·88	34·38
Soda	7·03	7·11
Water	5·58	4·01
Magnesia	2·32	2·64
Lime	0·02	0·25

3. Its localities are Orange River, Africa, Greenland, Norway and Golling Salzburg.

KUPAPHRITE. Prismatic Euchlore-Mica. Mohs.

Primary form. Right rhombic prism, dimensions unknown.

Secondary form. Primary, having the acute lateral edges truncated.

Kupaphrite.

Cleavage, parallel with P perfect. Fracture not observable. Surface, M deeply streaked in a horizontal direction. The rest of the faces smooth.

Lustre pearly upon P, both as faces of crystallization, and of cleavage; vitreous upon the other faces. Color pale apple-green and verdigris-green, inclining to sky-blue. Streak of the same color, only paler. Translucent, generally only on the edges.

Very sectile. Thin laminæ, flexible. Hardness = 1·0 ... 1·5. Sp. gr. = 3·098, of a crystallized variety from Schwatz.

Compound Varieties. Reniform and botryoidal shapes: surface drusy, composition columnar, faces of composition a little rough.

1. Alone, before the blow-pipe, it decrepitates very briskly, and throws around powdered fragments, which color the flame green. In the process, it immediately turns black, and melts into a steel-grey pearl, destitute of crystalline facets. On charcoal, it quietly emits moisture, without detonation; but after a longer exposure to the influence of the flame, it swells a little through the extrication of arsenical vapor. With carbonate of soda, an imperfectly fluid mass is obtained, which contains a nucleus of white metallic matter.

2. *Analysis.*

By Kobell.

From Falkenstein in the Tyrol.

Arsenic acid	25·366	25·01
Oxide of copper	43·660	43·88
Water	19·824	17·46
Carbonate of lime	11·150	13·65

3. It occurs in beds and veins, accompanied by other ores of copper, particularly by Blue Malachite.

4. The known localities of Kupaphrite are, the Bannat of Temeswar, Libethen in Hungary, Schwatz in the Tyrol, Saalfeld in Thuringia, and Matlock in Derbyshire.

KUPFERINDIG. (See *Purple Copper-Ore.*)

KUPFERSCHAUM. (See *Kupaphrite.*)

KUPHOLITE.

Massive: the individuals flat, also impalpable.

Lustre pearly. Color, yellowish white, wax-yellow, light yellowish brown. Streak white. Transparent, to translucent.

Hardness = ·5 . . . 1·00. Sp. gr. = 1·922 . . . 1·934.

1. It yields, when calcined, about 25 p. c. of water.

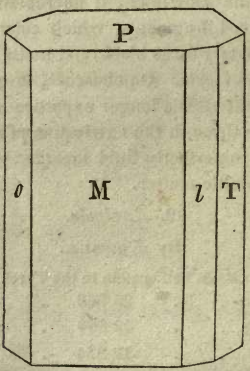
2. It occurs at Schwarzenberg, in the Erzgebirge, accompanied with the Metaxite and Kryptose Carbon-Spar of BREITHAUPT.

KYANITE. Prismatic Disthene-Spar. MOHS.

Primary form. Doubly oblique prism. P on M=93° 15′. P on T=100° 50′. M on T=106° 15′.

Secondary form.

Fig. 271.



P on *l*	-	97°	48′		T on *l*	-	140° 55′
P on *o*	-	83	38	PHILLIPS.	T on *o*	-	122 20
M on *l*	-	145	16				

Cleavage, parallel with M highly perfect, and easily obtained; less distinct parallel with T; least of all, parallel

with P. Fracture uneven. Surface streaked parallel to the common edges of intersection.

Lustre pearly upon M, particularly if the face is produced by cleavage; inclining to vitreous upon the other faces. Color generally white, often passing into blue, sometimes inclining to green or grey, and rarely to black. Frequently spots of berlin-blue elongated in one direction, upon a paler ground.

Streak white. Transparent . . . translucent.

Brittle. Hardness = 5·0 . . . 7·0; the lowest degrees upon M, the highest on the solid angles and edges. Sp. gr. = 3·675, a blue, transparent variety cut and polished; 3·559, a milk white variety of Rhaetezite.

Compound Varieties. Twin-crystals: faces of composition parallel, axis of revolution perpendicular to M. Massive: composition broad columnar, sometimes straight lamellar, often curved, or divergent; faces of composition in most cases irregularly streaked.

1. Two varieties were formerly distinguished as particular species, *Kyanite* and *Rhætizite:* the former referring simply to such varieties as are blue, the latter to those whose color is white. The *Fibrolite* of Count Bournon must also coalesce with the present species, with which it perfectly agrees in every property.

2. Before the blow-pipe, Kyanite is infusible. With borax, it is soluble with great difficulty. Some crystals exhibit positive, others negative electricity, on being rubbed.

3. *Analysis.*

	By Saussure.	By Laugier.	By Klaproth.	By Chenevix. var. Fibrolite.
Alumina	54·50	55·50	55·50	58·25
Silica	30·62	38·50	43·00	38·00
Lime	2 02	0·50	0·00	0·00
Magnesia	2·30	0·00	0·00	0·00
Oxide of iron	6·00	2·75	0·50	0·75
Water	4·56	0·75	0·00	0·00
Potash	0·00	0·00	a trace	0·00

4. The varieties of Kyanite occur in crystals, or massive, imbedded in rocks of the primitive class, as gneiss and mica slate; and are often attended by Garnet and Staurotide.

5. Crystals, and large cleavable varieties, are found at St. Gothard in Switzerland, the Zillerthal in the Tyrol, the Saualpe in Carinthia, and the Bacher mountain in Stiria. The variety *Rhætizite* is chiefly known from Pfitsch in the Tyrol. The *Fibrolite* has been brought from the Carnatic and from China, where it was found in loose crystals, accompanying Corundum.

Several very interesting localities of Kyanite are known in the United States, the most important of which is that in Massachusetts, at Chesterfield, where it occurs in mica-slate, accompanied by Garnet. Nodular masses of Quartz, one or two feet in thickness, are here occasionally penetrated throughout with crystals, and cleavable masses of the present species, often of a handsome blue color. Large rolled masses, sometimes above a foot in diameter, of a similar variety, occur at Litchfield and West Farms, (Conn.) containing also Corundum and massive Apatite. The variety Fibrolite occurs in very distinct prisms, at Lancaster, (Mass.) and at Bellows Falls, (Vt.); at both places in gneiss. A black variety is found in North Carolina, in the soil, accompanied by crystals of Rutile.

6. Blue varieties of Kyanite are sometimes cut as gems.

KYMATINE.

Massive: composition columnar, individuals thin, and arranged so as to produce an undulating structure: also impalpable. Lustre pearly. Color greenish-grey. Streak white. Rather brittle. Hardness = 2·0 ... 3·00. Sp. gr. = 2·923 ... 2·981.

Locality not mentioned.

LABRADORITE. Polychromatic Feldspar. PARTSCH.

Primary form. Doubly oblique prism. P on M = 94° 30′. P on T = 119°. M on T = 115°.

Secondary forms. These are analogous to those of Albite, but they present less variety, and on account of their rarity in general, have been but little investigated.

Labradorite.

Cleavage parallel with P and M most distinct, that in the direction of the remaining primary face very imperfect.

Lustre, upon the cleavage planes of P pearly, passing into vitreous. Color white, passing into grey, with a tinge of blue. Opalescent and iridescent tints appear in directions not coincident with the cleavages.* Translucent on the edges.

Brittle. Hardness $=6{\cdot}0$. Sp. gr. $=2{\cdot}69 \ldots 2{\cdot}76$.

1. Before the blow-pipe, Labradorite resembles Feldspar. With oxide of nickel and borax, it affords a blue pearl. It is entirely dissolved by heated muriatic acid.

2. *Analysis.*

By KLAPROTH.

	from Labrador.	from Saxony.
Silica	55·75	51·00
Alumina	26·50	30·50
Lime	11·00	11·25
Soda	4·00	4·00
Oxide of iron	1·25	1·75
Water	0·50	1·25

3. Labradorite occurs in sienitic rocks; also as a regular constituent in several kinds of gabbro rocks, with serpentine.

4. It was first brought from the coast of Labrador. It occurs also in Ingria, in large, but ill defined crystals, in Greenland, and as a constituent of several rocks in various places of the Hartz, Saxony, near Florence, &c. The variety commonly quoted from Norway, in the zircon-sienite of Friedrichsvärn, belongs to the species of Feldspar, and not to Labradorite.

Labradorite is but little known in the U. S. But one locality of any importance is known to exist in the country, which is situated at the distance of 60 miles west of Mount Moriah, upon Lake Champlain, (N.Y.) in an almost uninhabited country. It here exists in the greatest abun-

* From the researches of Dr. BREWSTER, it appears that these tints arise from the existence of empty crystallized cavities distributed through the mass.

Latrobite.

dance, in granite, and presents the same handsome colors as the variety from Labrador. It is occasionally met with also in rolled masses, in the vicinity of Pompton plains, (N. J.) and at Amity, (N. Y.)

LANARKITE. (See *Dyoxylite.*)

LAPIS-LAZULI. (See *Sodalite.*)

LATROBITE. Eruthrone Feldspar.

Primary form. Doubly oblique prism. P on M = 91° 9′. P on T = 98° 30′. M on T = 93° 30′; obtained from cleavage.

Color pale red.

Hardness = 5·75 ... 6·50. Sp. gr. = 2·8, BROOKE. 2·72, GMELIN.

1. It fuses before the blow-pipe, in the platina forceps, into a white enamel. With borax, it yields a globule, pale amethyst red in the oxidating flame, and colorless in the reducing one. With salt of phosphorus, a globule with a silica skeleton, is obtained, yellow in the oxidating flame, and becoming opake on cooling, transparent in the reducing flame.

2. *Analysis.*

		By GMELIN.	
Silica	44·653		41·780
Alumina	36·814		32·827
Lime	8·291		9·787
Oxide of manganese	3·160		5·767
Magnesia with some manganese	0·528		0·000
Potash	6·575		6·575
Water	2·041		2·041

3. It occurs in Amitok island, near the coast of Labrador, with Mica and Calcareous Spar.

END OF THE FIRST VOLUME.

UNIVERSITY OF CALIFORNIA

TREATISE

ON

MINERALOGY:

SECOND PART,

CONSISTING OF

DESCRIPTIONS OF THE SPECIES, AND TABLES ILLUSTRATIVE OF THEIR NATURAL AND CHEMICAL AFFINITIES.

BY

CHARLES UPHAM SHEPARD, A. B.

Lecturer on Natural History in Yale College; Member of the Amer ican Geological Society; Corresponding Member of the Academy of Natural Sciences of Philadelphia; of the Natural History Society of Montreal, and of the Geological Society of France, &c.

VOLUME II.

NEW HAVEN:

HEZEKIAH HOWE & CO.

1835.

Entered according to an Act of Congress, in the year 1835,
by CHARLES UPHAM SHEPARD,
in the Clerk's office, of the District Court of Connecticut.

Printed by Hezekiah Howe & Co.

GENERAL DESCRIPTIONS

OF THE

SPECIES.

LAUMONITE. Diatomous Kouphone-Spar. Mohs.

Primary form. Oblique rhombic prism: (oblique from an acute edge.) M on M′=86° 15′. M on P=113° 30′. Iceland. Nova-Scotia.

Secondary forms.

1. Fig. 272.

M on *c* - - 104° 20′. Phillips.

2. Primitive form, with the lateral edges truncated. Schemnitz, Hungary.

3. The same, with the addition of plane *c*, and the truncation of the obtuse lateral edges. Huelgoet, Brittany.

Cleavage, parallel with the shorter diagonal, distinct; traces of, parallel with the longer. Fracture uneven, scarcely observable. Surface P either smooth or uneven.

The faces parallel to the principal axis striated in that direction.

Lustre vitreous, inclining to pearly upon the more distinct faces of cleavage. Color white, passing into reddish, yellowish, or greyish tints. Streak white. Translucent. Not very brittle. Hardness = 1·5 ... 5·5. Sp. gr. = 2·3.

Compound Varieties. Massive: composition granular, commonly elongated in one direction, faces of composition generally streaked.

1. Before the blow-pipe, it melts into a white spumous mass. It gelatinizes with acids, and acquires negative electricity by friction, if isolated. It is decomposed by the action of the atmosphere, and loses its water; it is therefore generally met with in a friable state, and most of its properties are on that account but imperfectly known.

2. *Analysis.*

	By GMELIN.	By VOGEL.
Silica	48·30	49·00
Alumina	22·70	22·00
Lime	12·10	9·00
Water	16·00	17·50
Carbonic acid	0·00	2·50

3. It occurs in veins, traversing clay-slate with limestone: also in irregular veins and imbedded masses in porphyry, and in the cavities of amygdaloidal rocks.

4. The original locality is in the lead mines of Huelgoet in Brittany, It was next found near Schemnitz in Hungary, in porphyry. It occurs likewise on Mount St. Gothard with Apatite, in Faroe, Iceland, and various parts of Scotland, Ireland, and in Nova-Scotia.

In the United States it has been met with occasionally, in small masses, in the amygdaloid of Connecticut and Massachusetts; and at Phillipstown, (N.Y.)

LAZULITE. Prismatic Azure-Spar. MOHS.

Primary form. Right rhombic prism. M on M = 121° 30′.

Lazulite.

Secondary form. Fig. 273.

M on M	-	121°	30′	*a* on *e*	-	158°	10′
M on *e*	-	138	45	*c*1 on *c*1	-	120	40
M on *d*	-	140	30	*c*1 on *c*2	-	150	00
M on *f*	-	150	45	*e* on *d*	-	162	36
a on *a*	-	91	30 *	*c*1 on *e*	-	139	25
a on *c*1	-	129	10	*c*1 on *d*	-	141	20

Cleavage, parallel with *a* indistinct. Fracture uneven. Surface smooth, all the faces alike.

Lustre vitreous. Color various shades of a pure blue color, particularly deep and beautiful if viewed in the direction of one line, apparently the axis of the crystals; while perpendicular to it, it is of a pale greenish blue color. Streak white. Translucent, generally only on the edges, opake.

Brittle. Hardness = 5·0 . . . 5·5. Sp. gr. = 3·056.

Compound Varieties. Massive: composition granular, individuals strongly connected.

1. Before the blow-pipe, it intumesces a little, and assumes a glassy appearance, where the heat has been highest, but does not melt. With borax, it yields a clear colorless globule. Treated with boracic acid and a piece of iron-wire, it gives a globule of phosphuret of iron.

2. *Analysis.*

By Fuchs.

Phosphoric acid	-	41·81
Alumina	-	35·73
Magnesia	-	9·34
Silica	-	2·10
Protoxide of iron	-	2·64
Water	-	6·06

* These planes may be taken also as the primary planes.

Leadhillite.

3. It has been found in narrow veins, traversing clay-slate, both massive and crystallized with Quartz and Spathic Iron, near Werfen in Salzburg.

LEADHILLITE. Axotomous Lead-Baryte. Mohs.

Primary form. Rhomboid. P on P=72° 30′.

Secondary forms.

Fig. 274.

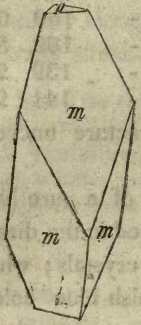


Fig. 275.

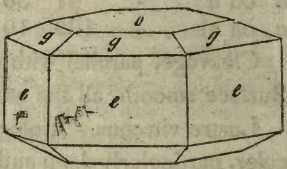
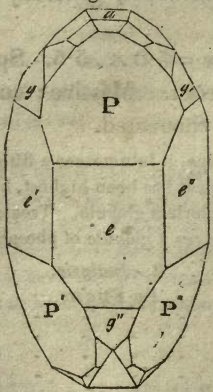


Fig. 276.



P	on	a	-	-	-	-	111° 30′
g	on	a	-	-	-	-	111 30
$d1$	on	a	-	-	-	-	131 58

Leadhillite.

Cleavage, parallel to *o*, and traces parallel to *a*. Fracture conchoidal, scarcely observable. Surface *o* very smooth and even; some of the faces curved or uneven.

Lustre resinous, inclining to adamantine, pearly upon *o*. Color yellowish white, passing into various, pale grey, green, yellow, and brown tints. Streak white. Transparent . . . translucent.

Rather sectile. Hardness = 2·5. Sp. gr. = 6·266.

Compound Varieties. Twin-crystals, frequent. Massive: composition lamellar, or granular.

1. Before the blow-pipe, this mineral first intumesces a little, and then becomes yellow, but re-assumes a white color on cooling. It effervesces briskly in nitric acid, and leaves a white residue.

2. *Analysis.*

By Berzelius.

Carbonate of lead	71·1
Sulphate of lead	30·0

With traces of muriatic acid, giving an excess of 1·1, probably owing to the existence of a subsalt of lead in the mineral.

3. It occurs principally at the Lead Hills of Scotland, in a vein traversing greywacke, accompanied with various other ores of lead: it has been brought from Spain under similar circumstances.

Leelite.

Massive. Fracture splintery. Lustre and translucency like horn. Sp. gr. = 2·71.

1. *Analysis.*

By Mitchell.

Silica	81·91
Alumina	6·55
Protoxide of iron	6·42
Potash	8·88

2. The specimens were brought from Gryphytta in Westmania, Sweden.

3. It scarcely admits of a doubt, that the Leelite is a variety of Feldspar.

Lenzinite.

An impure variety of Opal, in a state of partial decomposition.

LEPIDOKROKITE. (See *Limonite.*)

LEPIDOLITE. (See *Mica.*)

LEUCITE. Trapezoidal Kouphone-Spar. MOHS.

Primary form. Cube.

Secondary form. Trapezohedron. Irregular forms and grains.

Cleavage, very imperfect parallel to the primary form, and also to the faces of the rhombic dodecahedron. Fracture conchoidal. Surface of crystals even, though generally rough; of grains, uneven and smooth.

Lustre vitreous. Color reddish, yellowish, or greyish-white; ash grey or smoke grey. Streak white. Semi-transparent . . . translucent.

Brittle. Hardness = 5·5 . . . 6·0. Sp. gr. = 2·483.

Compound Varieties. Massive: composition granular; faces of composition irregularly streaked. Rare.

1. Alone before the blow-pipe, it is infusible: with borax, or carbonate of lime, it fuses with difficulty into a clear globule. Reduced to powder, it is said to change the color of the blue tincture of violets to green.

2. *Analysis.*

	By KLAPROTH.		By ARFWEDSON.
	fr. Vesuvius.	fr. Albano.	fr. Albano.
Silica . .	53·750 .	54·00 .	56·10
Alumina . .	24·625 .	23·00 .	23·10
Potash . .	21·350 .	22·00 .	21·15
Oxide of iron .	0 000 .	0·00 .	0·90

3. It occurs chiefly in imbedded crystals and grains in lava, sometimes in compound specimens ejected by Mount Vesuvius. Besides this locality, it is also found at Albano and Frescati near Rome.

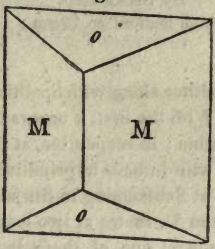
LEUCOPYRITE. Axotomous Eruthleucone-Pyrites.

Primary form. Right rhombic prism. M on M = 122° 26′.

Leucopyrite.

Secondary form.

Fig. 277.



Stiria—Bedford co. (Penn.)

o on *o*	-	-	-	-	-	51°	30′
M on *o*	-	-	-	-	about	146	00

Cleavage, perfect parallel to the longer diagonal; less distinct parallel with two faces on the acute lateral edges, inclining under 86° 10′; traces parallel with M. Fracture uneven. Surface faintly streaked, parallel to the common edges of combination, frequently smooth.

Lustre metallic. Color between silver-white and steel-grey. Streak greyish-black.

Brittle. Hardness = 5·0 . . . 5·5. Sp. gr. = 7·228, from Silesia; 7·337, crystal from Bedford co. (Penn.)

Compound Varieties. Massive: composition granular, individuals small, often nearly impalpable, and strongly connected; fracture uneven; composition columnar, rather thick, irregular, and divergent. Faces of composition irregularly streaked.

1. It is sometimes magnetic even with polarity. It melts before the blow-pipe, without giving any perceptible smell of arsenic; but when fused in quantity beneath the flame of the compound blow-pipe, the odor of arsenic is perceptible. It is perfectly soluble in nitric acid,—a few flakes of Plumbago, only, remaining undissolved in the solution.

2. *Analysis.*

By SHEPARD.

From Bedford co. (Penn.)

Iron	97·44
Arsenic	1·56

3. It is found in beds, either along with Spathic Iron and Limonite, or imbedded in serpentine. With the first, it occurs in the valley of Löling, near Huttenberg in Carinthia; in serpentine, at Reichenstein in Silesia. It has likewise been met with in beds in primitive mountains, with Copper-Nickel and Smaltine, at Schladming in Stiria.

It has been found in the U. States at two localities, but under what circumstances, it is not known: one of them is in Bedford co. (Penn.) from whence a crystal weighing two or three ounces, was brought; and the other, in Randolph co. (N. Carolina) where a mass, weighing nearly two pounds, was obtained.

LEVYNE. Macrotypous Kouphone-Spar. PARTSCH.

Primary form. Rhomboid. P on P=79° 29′.

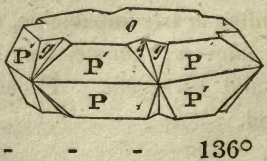
Cleavage, indistinct parallel to P. Fracture, imperfectly conchoidal.

Lustre vitreous. Color white. Streak white. Semi-transparent.

Brittle. Hardness =4·0. Sp. gr. =2·198.

Compound Varieties. Composition parallel to *o*.

Fig. 278.



o on *g*	136° 1′	LEVY.
o on P	117 29	

Surface *o* uneven, and generally curved.

1. In the glass tube, when heated, it gives off a considerable quantity of water, and becomes opake. Upon charcoal, it intumesces slightly.

With salt of phosphorus, it yields a transparent globule, which contains a skeleton of silica, and becomes opake on cooling.

2. *Analysis.*

	By Berzelius.	By Connel.
Silica	48·00	46·30
Alumina	20·00	22·47
Lime	8·35	9·72
Magnesia	0·40	0·00
Potash	0·41	1·26
Soda	2·75	1·55
Oxide of iron	0·00	0·77
Oxide of manganese	0·00	0·19
Water	19·30	19·51

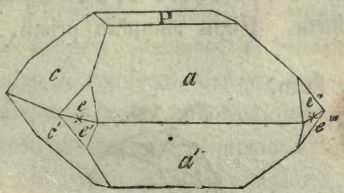
3. It occurs at Dalsnyhen in Faroe; in Ireland, and in the island of Skye, with Heulandite, in the vesicular cavities of amygdaloid.

LIBETHENITE. Diprismatic Copper-Baryte.

Primary form. Right rhombic prism. M on M=110°.

Secondary form.

Fig. 279.



x on *x*	110°	00′?	Phillips.
P on *c*	126	10	
a on *a'*	95	15	
c on *c*	121	15	
c on *e*	149	10	

Cleavage, parallel with P and M: the former distinct. Fracture conchoidal, uneven. Surface of P very smooth and even; M striated parallel to its edges of combination with P.

Lustre resinous. Color olive-green, generally dark. Streak olive-green. Translucent on the edges.

Brittle. Hardness = 4·0. Sp. gr. = 3·6 . . . 3·8.

1. Before the blow-pipe, on the first impression of heat, it fuses into a brownish globule, which, by further action of the heat, extends on the surface of the charcoal, and acquires a reddish grey, metallic lustre, and finally gives, at the centre, a small globule of metallic copper.

2. *Analysis.*

By BERTHIER.

Oxide of copper	63·9
Phosphoric acid	28·7
Water	7·4

3. It occurs engaged in cavities of Quartz, associated with Yellow Copper Pyrites, in a bed, in primitive rocks, at Libethen, near Neusohl, Hungary; also at Gunnis lake mine in Cornwall.

LIEVRITE. (See *Yenite.*)

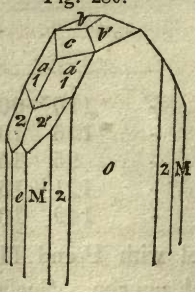
LIMBILITE. (See *Peridot.*)

LIMONITE. Prismatic Iron-Ore. MOHS.

Primary form. Right rhombic prism. M on M′ = 130° 40′.

Secondary form.

Fig. 280.



The crystals are compressed parallel with the shorter diagonal of the prism, so as to give an undue extension to the planes *o o* of the above figure.

Limonite.

M′ on M over *e*	130°	40′	PHILLIPS.	*c* on M′	-	120°	42′
o on *a*2′ -	135	5		*c* on *b* or *b*′ -	135	20	
o on *b*′ -	121	45		*b* on *a*2 or *b*′ on *a*2′ -	121	25	
o on M′ -	117	50		*a*1 on M -	129	30	
a′1 on *a*1 -	125	30		*a*2 on M -	153	25	
*a*2 on *a*2′ -	149	24		*a*2 or *a*2′ on *c*	147	00	
b on *b*′ -	117	30					

Cleavage, pretty distinct parallel to the broad faces of the crystals, or the shorter diagonal of the prism. Surface deeply striated lengthwise of the prism.

Lustre adamantine. Color, various shades of brown; of which yellowish brown, hair-brown, clove-brown and blackish brown, are the most common. Streak yellowish brown. Crystals often semi-transparent, and showing a blood red tint. Other varieties are nearly opake.

Brittle. No action on the magnet. Hardness = 5·0... 5·5. Sp. gr. = 3·922, of a columnar, compound variety.

Compound Varieties. Globular, reniform, stalactitic and fructicose shapes: surface, of various descriptions, smooth, granulated, reniform, drusy; composition columnar, individuals very delicate, often impalpable. In the latter case, fracture becomes even, flat conchoidal, or uneven. The composition is often repeated; granular and curved lamellar masses are formed of columnar compositions, the faces of composition being either smooth, or covered with reniform asperities. Massive: composition columnar or impalpable. Sometimes the particles are so slightly coherent, that the mass appears earthy and dull. Pseudomorphoses of Calcareous Spar.

1. The present is one of those species in mineralogy, which, on account of the varieties in regard to composition, and the intermixture of other species, has been treated of under a great diversity of names, as

constituting sub-species, notwithstanding the close connexion of these varieties thus distinguished, by immediate inter-transitions. In the first place, some of what are generally regarded as pseudomorphoses, or suppositious crystals, must be excluded, because they are not real pseudomorphoses, consisting of compound varieties of this species, but are decomposed varieties of three others, viz. Iron Pyrites, White Iron Pyrites and Spathic Iron, to which they must be severally referred. The *Fibrous* Limonite, or Brown Hematite, contains the real crystals, and the compound varieties in stalactitic, reniform, and other imitative shapes; also those massive varieties in which the composition may still be ascertained. A crystallized variety, in thin laminæ, has been called *Rubinglimmer* or *Göthite*. *Compact* Brown Iron-Ore comprehends those imitative shapes and massive varieties, in which the composition is no longer observable, but which are still firmly connected; while *Ochrey* Brown Iron-Ore is applied to those which have an earthy texture, and are friable. As impure varieties of this species, or those in which other species are mechanically blended, we must consider some of the clay Iron-Ores, such as the *Granular*, the *Common*, the *Pisiform*, and the *Reniform* clay iron-ore. The granular variety is composed of compact roundish or globular masses; the reniform ore, of alternating coats of different color and consistency, disposed in a reniform surface. In the pisiform variety, we meet with a similar composition, only in small globules, parallel to the surface of which the laminæ are disposed. The compact pisiform clay iron-ore, however, does not belong to the present species, but it is a decomposed White Iron Pyrites, as is proved not only by the crystalline forms which it presents, and which are described in books, but likewise from the nucleus of undecomposed pyrites, which larger specimens of it often contain. To this species also appear to belong several scaly and nearly impalpable varieties of Iron-Ore, as the Lepidokrokite, Pyrrhosiderite, and Sideroschisolite; though it is probable that some of them contain scales of Specular Iron also.

2. Before the blow-pipe, it becomes black and magnetic. It melts with borax, into a green or yellow glass, and is soluble in heated nitro-muriatic acid.

3. *Analysis.*

By D'Aubuisson.

	A fibrous variety.	A compact variety.
Peroxide of iron	82·00	84·00
Water	14·00	11·00
Oxide of manganese	2·00	2·00
Silica	1·00	2·00

Limonite.

It is a hydrate of peroxide of iron, the proportions of peroxide of iron and water, being as 85·30 to 14·70.

4. Limonite occurs in beds and veins. When in beds, it is generally accompanied by Spathic Iron, sometimes also by Heavy Spar, Calcareous Spar, Arragonite and Quartz. These beds are included both in ancient and in secondary rocks, the latter of which, though very thick, do not extend to a very great distance. When in veins, this species is frequently attended with some of the ores of manganese. Acicular crystals of Limonite are met with in geodes of Quartz. Those varieties of clay iron-stone which belong to the present species, either form beds by themselves in secondary rocks, or they are imbedded in strata of clay, in the shape of larger or smaller globular concretions, some of them belonging to the coal formation, others to various kinds of sandstone.

5. Limonite is very plentiful in some countries. It occurs in beds in gneiss, along with granular limestone, at Friesach, at Hüttenberg, and in the valley of Lavant in Carinthia, at Turrach and Eisenerz in Stiria. Other localities, under similar circumstances, in Europe, are, Torotsko in Transylvania; Dobschau, Szirk, &c., in Hungary; Schneeberg in Saxony; Kamsdord and Saalfield, in Thuringia: though at some of these places it is said to occur in newer rocks. It is found in veins in various parts of Saxony, Nassau, the Hartz, &c. Göthite is found in the districts of Siegen and Sayns; the velvety varieties at Przibram in Bohemia; several crystallized varieties in the vicinity of Bristol, England, and in the lake of Onega in Russia. Rich varieties of the clay iron-ore occur in Bohemia, in Silesia, at Wehrau in Lusatia, and in Westphalia. The kidney shaped variety is met with near Teplitz in Bohemia, Tarnowitz in Silesia, in Poland, in several districts of Lower Stiria, &c. The pisiform clay iron-ore is found in Swabia, Franconia, Hessia, and in the district of Ayrshire in Scotland.

Limonite is one of the most widely diffused mineralogical species of the United States. Powerful beds of the fibrous brown hæmatite, accompanied by the ochery iron-ore, exist at Salsbury and Kent, in Connecticut, contained in mica-slate. In the neighboring towns of Beekman and Amenia, (N.Y.) similar deposits are met with. Farther north, under the same circumstances, at Richmond and Lenox, (Mass.) the like varieties of the present species occur. The mica-slate, which embraces the foregoing varieties, contains also beds of dolomite. At Hinsdale, the fibrous variety occurs as a cement to a fragmentary quartz rock. The nodular variety occurs at Gill, in the slate of the coal formation; it

is also abundant on Nantucket and Martha's Vineyard. Limonite is abundant at Bennington, Monkton, Pittsford, Putney and Ripton, in Vermont; at all of which places, it is more or less associated with ores of manganese. The argillaceous varieties are common in Pennsylvania, near Easton, and throughout the Lehigh range, in Fayette county at Armstrong, Upper Dublin, and in Washington county. Nodular argillaceous iron, in hollow balls from one inch to one foot in diameter, occur at Bladensburg, (Maryland.) Argillaceous iron-ore exists on mount Alto, in the Blue Ridge, at Hugh's mine, in Shenandoah co. (Va.); and in Chatham and Nash counties in North Carolina. Nodular fragments, which are perfectly compact and hard, occur disseminated through gravel-hills, near Marietta, in Ohio.

6. Limonite yields a considerable portion of the iron annually produced in the different parts of the globe. The pig-iron, obtained from melting its purer varieties with charcoal, in particular, may be easily converted into steel. The hard and compact nodular variety is much esteemed as a burnisher, in the polishing of metallic buttons.

Lincolnite.

Primary form. Right oblique angled prism. M on M = 120° c. g.

Secondary form. The primary, with the acute lateral edges truncated.

Cleavage, perfect parallel with P.

Lustre pearly on P. Color white. Transparent to translucent.

1. On hot coals, it whitens; and before the blow-pipe, melts into a spongy, white enamel.

2. It is found in the amygdaloidal cavities of trap at Deerfield, (Mass.) and upon gneiss, at Bellow's Falls, (Vt.)

3. As the largest crystals of this substance do not exceed one tenth of an inch in diameter, and as the angles given were obtained with the common goniometer, it will be necessary that their correctness be confirmed by the reflective goniometer, before the evidence that they are distinct from Heulandite, can be considered as completely satisfactory.

LIROCONITE. Lirokone Malachite-Haloide.

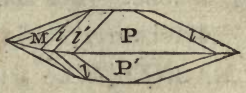
Primary form. Octahedron, with a rectangular base. P on P = 60° 40′. M on M′ = 72° 22′.

Liroconite.

Secondary form.

P on l'	179°	22′	Phillips.
M on P	133	30	
l on l	178	10	

Fig. 281.



Cleavage, parallel with the primary planes, but effected with much difficulty. Fracture imperfectly conchoidal, uneven.

Lustre vitreous, inclining to resinous. Color sky-blue ... verdigris-green. Streak corresponding to the color, very pale. Semi-transparent ... translucent.

Nearly sectile. Hardness = 2·0 ... 2·5. Sp. gr. = 2·926.

Compound Varieties. Massive; composition granular, sometimes very distinct, but altogether rare.

1. Before the blow-pipe, it loses color and transparency, emits fumes of arsenic, and is changed into a friable scoria, containing some white, metallic globules. With borax, it yields a green globule, and is partly reduced. In nitric acid, it is soluble without effervescence.

2. *Analysis.*

By Chenevix.

Oxide of copper	49·00
Arsenic acid	14·00
Water	35·00

3. Lenticular Copper-Ore occurs in copper veins, along with various other ores of copper; also with Limonite, Quartz and Iron Pyrites.

4. It has been found only in some of the copper mines, near Redruth in Cornwall, and in minute crystals at Herrengrund in Hungary.

Lithomarge.

A pure, white, adhesive clay, from the decomposition of one or more species. That from Rochlitz in Saxony, consists, according to Klaproth, of

Silica	45·25
Alumina	36·50
Water	14·00
Oxide of iron	2·75

Magnesite.

LYDIAN STONE. (See *Quartz.*)

MACLE. (See *Andalusite.*)

MACLURITE. (See *Brucite.*)

MAGNESITE. Staphyline Lime-Haloide.

Reniform, tuberose, massive. Composition columnar, individuals very delicate and diverging, producing a silky lustre; also impalpable. Fracture flat conchoidal, sometimes fine earthy.

Dull. Color yellowish grey, cream-yellow, yellowish and greyish white. Streak white and greyish white. Feebly translucent on the edges . . . opake.

Sp. gr. = 2·808. (No allowance being made for its imbibition of water.)

Adheres pretty strongly to the tongue.

1. Several varieties of the present species are distinguished by particular denominations. 1. *Meerschaum* or *Sea-foam*, which is contaminated with variable proportions of silica: it is opake, and possessed of an earthy fracture, yields easily to the nail, and adheres strongly to the tongue; occasionally it is very porous, so as to swim on water. Sp. gr. = 1·2 . . . 1·6. According to BERTHIER, a specimen from near Madrid, consisted of magnesia 23·8, silica 53·8, water 20·0, alumina 1·2.—2. *Compact Carbonate of Magnesia.* Color snow-white. Sp. gr. = 2·56. Gives sparks with steel, but does not scratch Fluor. It dissolves in acids, at ordinary temperatures, with extreme slowness, even when finely powdered; but by heat, its solution is quickened, attended with the extrication of carbonic acid gas. According to Dr. HENRY, it consists of magnesia 46, carbonic acid 51.—3. *Pulverulent Carbonate of Magnesia.* It is in the form of a light, white, powder, or in slightly cohering masses, resembling chalk. It appears to have resulted from the decomposition of Native Magnesia. It consists, according to WACHTMEISTER, who analysed a specimen from Hoboken, of magnesia 42·41, carbonic acid 36·82, water 18·53, silica and oxide of iron 2·23.

2. Before the blow-pipe, it is infusible. It dissolves with a slow effervescence in the nitric and dilute sulphuric, acids.

Magnesite.

3. *Analysis.*

	By Lampadius, from Mahren.	By Klaproth, from Steyermark.	By Walmstedt, from the Hartz.	By Bucholz, from Hrubschiz.	By Stromeyer, from Baumgarten.
Magnesia	47·0	48·0	40·84	46·59	47·63
Carb. acid	51·0	49·0	48·58	51·00	50·75
Water	1·6	3·0	10·51	1·00	1·40
Ox. mang.	0·0	0·0	1·99	0·25	0·21
Ox. iron	0·0	0·0	6·16	0·00	0·00
Alumina	0·0	0·0	0 00	1·00	0·00
Lime	0·0	0·0	0·00	0·16	0·00
Silica	0·0	0·0	0·30	0·00	0·00

4. It occurs at Gulsen in Upper Stiria, in serpentine; at Hrubschiz, in Moravia, with the variety Meerschaum; at Baldifrero and Castellamonte, in Italy; at Valeccas in Spain, and at Baumgarten in Silesia. The compact variety, analyzed by Dr. Henry, was from the East Indies. The Meerschaum occurs in the Isles of Samos and Negropont, in the Archipelago; at Kiltschik in Natolia, where it is soft when first taken from the locality, but hardens on exposure to the air. The pulverulent variety is found in India. In the U. S. it occurs at Hoboken, (N.J.) disseminated through mamillary Dolomite, filling up narrow seams and cavities among the concretions, in opake, closely aggregated, white fibres. At the same place, also, in the pulverulent state, occupying seams sometimes half an inch wide, and also in crusts coating capillary crystals of Arragonite, and masses of Native Magnesia. The mineral analyzed by Wachtmeister, from Hoboken, probably contained a large quantity of hygrometric moisture. At Bolton, (Mass.) it is found in seams, traversing white limestone, in delicate, scarcely perceptibly fibrous, masses.

5. Magnesite is employed in porcelain manufactories. The meerschaum is made into pipes, and in Turkey is used for the same purposes as Fuller's earth.

6. The crystals of Magnesite, quoted by some writers, appear to belong to the species Rhomb Spar. So far as its properties are known, its place in the natural arrangement would be either within the genus Lime Haloide, where it is here placed, or it would form a new genus, next, preceding or following this genus.

MAGNETIC IRON. Octahedral Iron-Ore. Mohs.

Primary form. Regular octahedron.

Secondary forms.

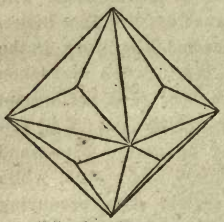
1.
Octahedron, with truncated edges.
Sweden. Haddam, (Conn.)
Franconia, (N. H.) Nova Scotia.

2.
Dodecahedron.
Traversella, Piedmont.
Franconia, (N. H.)

3.
Octahedron, with truncated angles.
Gulsen, Stiria.

4.
Cube.
Gulsen, Stiria.

5. Fig. 282.

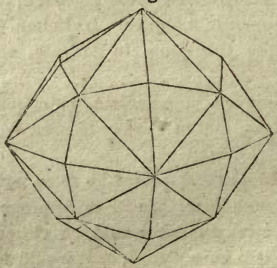


Zillerthal, Salzburg.

6. Fig. 283.

Zillerthal, Salzburg.

7. Fig. 284.



Zillerthal, Salzburg.

Irregular forms and grains.

Magnetic Iron.

Cleavage, parallel with the primary form: in some varieties perfect, and easily obtained; in others, entirely obliterated by conchoidal fracture. Fracture conchoidal, uneven. Surface, the dodecahedrons commonly streaked parallel to their edges of combination with the octahedron, faces of the octahedral trigonal-icositetrahedron (fig. 282.) smooth, though curved; the surface of all the other forms is smooth.

Lustre metallic; in some varieties, imperfectly. Color iron-black. Streak black. Opake.

Brittle. Hardness $=5{\cdot}5 \ldots 6{\cdot}5$. Sp. gr. $=5{\cdot}094$, octahedrons imbedded in chlorite.

Compound Varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel to a face of the octahedron. Massive: composition granular, of various sizes of individuals, and different degrees of cohesion. If the composition be almost impalpable, fracture becomes flat conchoidal, even or uneven.

1. Before the blow-pipe, it is infusible; but assumes a brown color, and loses its attractive influence over the magnetic needle, after having been exposed to a great heat. It is soluble in heated muriatic acid, but not in nitric acid. It may be obtained crystallized by fusing it; and crystals are likewise often produced in the process of roasting the ore which contains this mineral.

2. *Analysis.*

By Hisinger.

Protoxide of iron	94·38
Magnesia	0·16

The loss is oxygen, as the mineral contains both protoxide and peroxide of iron, according to Berzelius, in the proportion of 30·98 to 69·02, (the whole content of oxygen being 28·215,) or, according to Kobell, protoxide 24·48 to 25·92, and peroxide 74·08 to 75·52.

3. Magnetic Iron occurs in beds in primitive rocks, more commonly in gneiss, occasionally in clay-slate, hornblende-slate, chlorite slate,

greenstone, and sometimes in limestone. It is attended by Hornblende, Epidote, Pyroxene and Garnet.

4. Immense masses of this ore exist at Arendal in Norway, the Taberg in Smaland, in Sweden, and Chili. It occurs also in Saxony, Bohemia and the Hartz. It is met with in Corsica, in Unst, (one of the Shetland Isles,) in Russia and Siberia. It is also extremely abundant in the U. States. The most interesting crystallized varieties are found at Munroe, (N.Y,) lining the sides of veins in the massive ore; at Marlborough, (Vt.) imbedded in chlorite; and at Bridgewater, (Vt.) in chlorite slate; also at Franconia, (N.H.) imbedded in Epidote and Quartz. Immense beds of this ore exist in the gneiss, at different places upon the western side of Lake Champlain; also in the Highlands of New York, and in the mountainous districts of New Jersey and Pennsylvania.

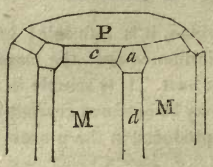
5. It is one of the most important ores of iron, in furnishing the metallic iron of commerce.

MAGNETIC IRON-PYRITES. Rhombohedral Bronze-Pyrites.

Primary form. Regular hexagonal prism.

Secondary form.

Fig. 285.



M on M′	-	-	120° 00′	Bournon.
M on *d*	-	-	150 00	
P on *a*	-	-	135 00	
P on *c*	-	-	102 13	

Cleavage, parallel with P perfect; less so with planes M. Fracture small, and imperfectly conchoidal. Surface rough, particularly M; sometimes also horizontally streaked. Subject to tarnish.

Magnetic Iron-Pyrites.

Lustre metallic. Color intermediate between bronze-yellow and copper-red. Streak dark greyish-black.

Slight action on the magnet. Brittle. Hardness =3·5 ...4.5. Sp. gr. =4·631, of a cleavable variety.

1. Heated in an open tube, it yields sulphureous acid; upon charcoal, in the exterior flame of the blow-pipe, it is converted into a red oxide of iron. In the interior flame, it melts with a good heat, into a globule, which continues to glow, a few moments after it is withdrawn from the fire. After cooling, it becomes an uneven, black mass. When broken, the fracture is crystalline, and the lustre metallic, with a yellowish color.

2. *Analysis.*

	By Hatchett.	By Rose.	By Stromeyer.	
Iron - -	63·50 -	38·78 -	59·85 -	56·37
Sulphur - -	36·50 -	60·32 -	40·15 -	43·63

The first of these analyses represents a bi-sulphuret of iron; the others are mixtures of the two sulphurets. It is often formed artificially in slags.

3. It occurs in beds along with other minerals containing iron, with Blende, Copper-Pyrites, and sometimes with Iolite. It forms an accidental ingredient of several rocks, and crystallizes in their fissures. Its presence has also been ascertained in several meteoric stones.

4. Small crystals occur at Andreasberg in the Hartz. The compound varieties occur more plentifully. There are cleavable ones at Bodenmais in Bavaria. Other varieties abound in Saxony, Silesia, the Hartz, and Stiria; also at Cornwall in England. The cleavable variety is found at Munroe, (Conn.) imbedded in Quartz, and attended by numerous ores; also in the next town, Trumbull, in a vein of Topaz and Fluor. The uncleavable variety occurs in Vermont, at Stafford and Shrewsbury; and at several places in Massachusetts; in which localities, it is attended by Iron Pyrites.

5. It is employed, along with Iron Pyrites, in the manufacture of copperas and sulphuric acid.

Malachite. (See *Blue Malachite* and *Green Malachite.*)

Malacolite. (See *Pyroxene.*)

MANGANBLENDE. Hexahedral Sclerone-Blende.

Primary form. Cube.

Secondary form. Regular octahedron.

Cleavage, parallel with the primary form, perfect; traces of cleavage, parallel with its edges. Fracture uneven, imperfectly conchoidal. Surface rough.

Lustre imperfectly metallic. Color iron-black. Streak dark-green. Opake.

Rather sectile. Hardness = 3·5 . . . 4·0. Sp. gr. = 4·014.

Compound Varieties. Massive: composition granular, of various sizes of individuals; faces of composition irregularly streaked, or rough.

1. Before the blow-pipe, it is melted with difficulty, and only on its thinnest edges. It emits sulphuretted hydrogen, if reduced to powder, and when thrown into nitric, muriatic, or dilute sulphuric, acid, it is dissolved.

2. *Analysis.*

	By KLAPROTH.	By VAUQUELIN.
Protoxide of manganese	82·00	85·00
Sulphur	11·00	15·00
Carbonic acid	5·00	0·00

It is generally, however, considered as a sulphuret of manganese.

3. It is a rare mineral. It occurs chiefly in veins along with Black Tellurium, at Nagyag in Transylvania, and in Cornwall.

4. DEL RIO mentions a variety of Manganblende, found at Oaxaca in Mexico, in which the cleavages are rhombohedral, and whose sp. gr. = 3·8. According to his analysis, it contains 41·7 sulphur, and 58·3 manganese.

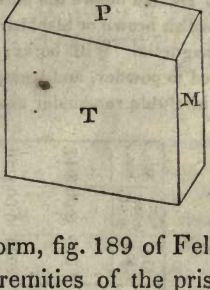
MANGANESE SPAR. Tetarto-prismatic Parachrose-Baryte.

Primary form. Doubly oblique prism.

Manganese Spar.

M on T	- - -	121°	00′
M on P	- -	93 to 94	00
T on P	- - -	112	30

Fig. 284.



Secondary form. Similar to the form, fig. 189 of Feldspar; but having the faces at the extremities of the prism curved, and somewhat indistinct.

Cleavage, parallel with P, highly perfect; with M and T less easily obtained. Fracture conchoidal . . . uneven. Most of the faces are smooth, though they possess a lustre much inferior to that of the cleavage planes.

Lustre vitreous. Color pale flesh-red. Streak white. Transparent to translucent. Grows brown and opake from exposure to the weather.

Brittle. Hardness = 5·5 . . . 6·0. Sp. gr. = 3·4 . . . 3·634.

Compound Varieties. Massive: composition granular, individuals sometimes large and lamellar, also fine granular, rarely columnar, strongly coherent. Sp. gr. = 3·612, from Longbanshytta; 3·634, from Siberia.

1. The supposed new species, *Fowlerite*, must be included within the Manganese Spar, as the most important properties of these minerals plainly show, although the Manganese Spar had never been observed in distinct crystals, previous to the discovery of the variety, Fowlerite. The substances called *Allagite*, *Corneous Manganese*, *Photizite*, and *Rhodonite*, are fine granular, or impalpable varieties, of the present species, occasionally mixed with a variable quantity of Spathic Iron. Their col-

Manganese Spar.

ors, are in general, several tints of green, brown and red, which become darker on exposure to the air.

2. Heated before the blow-pipe, it becomes dark-brown, and melts into a reddish brown or blackish glass, which in the variety from N. Jersey, is magnetic. With borax, it dissolves into a violet colored glass. Reduced to powder, and treated with muriatic acid, it is partly dissolved; the insoluble remainder assuming a white color.

3. *Analysis.*

Analysts.	Varieties analyzed, and localities.	Silica.	Oxide of manganese.	Oxide of iron.	Lime.	Magnesia.	Alumina.	Carbonic acid.	Water.
Thomson.	*Fowlerite*, Franklin, (N.J.)	29·48	deutox. 17·716 protox. 34·64	perox. 13·22	0·00	0·00	0·000	0·00	3·17
"	*Silicate of manganese*, Stirling, (N.J.)	29·64	protox. 66·60	perox. 0·92	0·00	0·00	0·000	0·00	2·70
Berzelius.	from Longbanshytta.	48·00	protox. 49·04	traces.	3·12	0·22	0·000	0·00	0·00
Brandes.	*Corneous mang'se*	34·00	54·857	0·50	traces.	0·00	0·000	8·00	2·00
"	"	31·00	54·929	0·50	1·00	0·00	0·000	10·00	1·5
"	Common variety.	35·00	57·162	0·250	0·00	0·00	0·000	5·00	2·50
"	*Rhodonite*,	39·00	49·37	0·25	0·00	0·00	0·125	4·00	6·00
Ruprecht.	from Kapnik.	55·06	35·15	7·04	0·00	0·00	1·56	0·00	0·78
Dumenil.	Compact variety.	54·37	41·25	0·00	1·25	0·00	0·000	0·00	0·00
Brandes.	"	53·50	41·382	1·00	0·00	0·00	1·242	0·00	3·00
"	*Photizite*, color isabella-yellow.	39·00	46·13	0·50	0·00	0·00	0·000	11·00	3·00
"	" grey.	36·00	37·393	0·50	0·00	0·00	6·000	14·00	6·00
Dumenil.	"	71·00	26·34	1·50	0·00	0·00	0·000	0·00	0·00
"	*Allagite*, green.	16·00	73·31	0·00	0·00	0·00	0·000	7·50	0·00
"	" brown.	16·00	75·00	0·00	traces.	0·00	0·000	7·50	0·00
Lampadius.	from Siberia.	30·00	61·00	5·00	0·00	0·00	2·000	0·00	0·00
Thomson.	from Cummington.	40·58	38·92	13·50	0·00	0·00	0·000	0·00	0·00

4. The variety Fowlerite occurs at Hamburgh, (N. J.) at the Franklin furnace, where it exists in the form of a bed in limestone, along with Magnetic Iron, Franklinite and Garnet. It also occurs at Sterling, (the variety which has been called Silicate of Manganese,) in a bed of Franklinite with Troostite, Automalite and Red Zinc-Ore; and again at Cumberland, (R.I.) where it is associated with Yenite.

The old variety, called Red Manganese, and Manganese Spar, is found at Longbanshytta in Sweden, in beds of iron-ore; near Elbingerode in the Hartz; in the district of Catherinenberg in Siberia; also near Callington in Cornwall. In the United States, it has been found abundantly at Cummington, (Mass.) where it exists in large, rolled masses, disseminated through the soil. The varieties called Allagite, Corneous Manganese, Photizite and Rhodonite, occur near Rübeland in the Hartz.

5. It is cut and polished by the lapidary, and employed for inlaid work.

6. It is difficult to decide whether Manganese Spar is with greater propriety placed within the genus Parachrose-Baryte, than in that of Augite-Spar. Its specific gravity, color, and liability to grow darker, from exposure to the weather, however, rather favor the disposition here made.

MANGANESIAN EPIDOTE. (See *Epidote.*)

MANGANITE. Prismatoidal Manganese-Ore. MOHS.

Primary form. Right rhombic prism. M on M = 99° 40′.

Secondary forms.

Fig. 287.

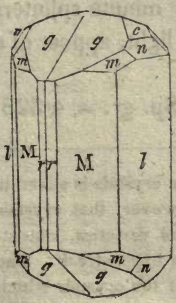
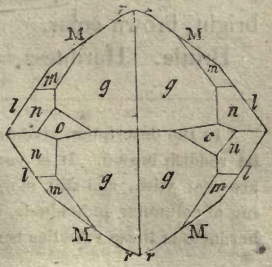
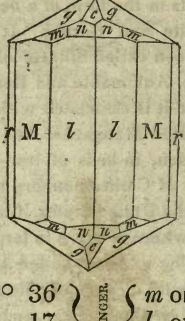


Fig. 288.



Manganite.

Fig. 289.



g on g	- -	172°	36′	}	HAIDINGER.	{	m on m	- -	112°	35′
c on c	- -	115	17	}		{	l on l	- -	51	18
n on n	- -	95	4	}		{	r on r	- -	134	14

Cleavage, parallel with l highly perfect, and easily obtained; with M also perfect, but less easily obtained; traces of r. Fracture uneven, surface of the vertical planes streaked parallel to their common edges of intersection. In general, the faces are smooth, and possess pretty high degrees of lustre.

Lustre imperfectly metallic. Color dark, brownish black, inclining to iron-black. Streak, reddish brown. Opake in larger masses; when broken, or cleaved in the direction of l, and exposed to the light of the sun, minute splinters are often observed, which, by transmitted light, appear of a bright, brown color.

Brittle. Hardness $=4{\cdot}0 \ldots 4{\cdot}25$.* Sp. gr. $= 4{\cdot}328$.

* In the description given above, the streak of the crystals is stated to be reddish brown. It is very often the case, however, that crystals are met with, and still more frequently compound varieties, consisting of columnar individuals, which actually afford a black streak. The hardness of these varieties is much inferior to that of the crystals which

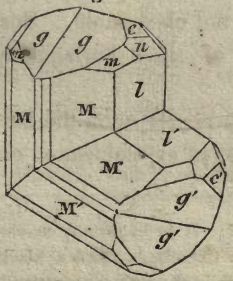
Manganite.

Compound Varieties. Twin-crystals. 1. Face of composition parallel to *l*, axis of revolution perpendicular to it.

Fig. 290.

A repetition of this law produces thick prisms, terminated perpendicularly upon their axis by a rough face, which consists of the apices of numerous individuals, or rather of numerous particles of two individuals, alternating with each other. 2. Axis of revolution perpendicular, face of composition parallel to a plane of the pyramid.

Fig. 291.



present a brown streak, being generally between 2·5 and 3·0; and sometimes in fibrous varieties, it is so inconsiderable as to soil the fingers and write upon paper. On the contrary, their specific gravity is higher, and

Massive: composition granular, or columnar,—the latter more frequently.

1. It is infusible before the blow-pipe, and colors glass of borax, violet-blue. It is insoluble in nitric acid. In heated sulphuric acid, it disengages chlorine. Also, before the blow-pipe, or alone, in a strong heat, it gives out oxygen.

2. *Analysis.*
By TURNER.

Protoxide of manganese - - - - -	80 92
Oxygen - - - - - - - -	8·98
Water - - - - - - - -	10·10

3. Manganite occurs in abundance, and great beauty, at Ihlefeld in the Hartz, and at Oehrenstock near Ilmenau in Thuringia.

MARCELLINE. (See *Black Manganese.*)

MAREKANITE. (See *Pitchstone.*)

MARGARITE. Rhombohedral Pearl-Mica. MOHS.

Primary form. Rhomboid, of unknown dimensions.

Secondary form. Hexagonal plates.

Cleavage, parallel with the bases of the hexagonal plates, highly perfect; also traces parallel with the sides of such plates. Fracture not observable. Surface of bases triangularly streaked, of sides horizontally streaked, though faintly.

Lustre, common pearly upon the bases of the hexagonal tables, both in faces of crystallization and of cleavage; vit-

---

often approaches to 4·7. It is important to observe, that the exterior strata of large crystals sometimes afford a black streak, and show low degrees of hardness, while the interior parts still offer the characters indicated in the preceding description. It would seem, therefore, that the difference in several of these properties, is owing to a change or decomposition of the substance itself, which does not affect the regular form.

reous upon the other faces. Color pale pearl-grey, passing into reddish-white and yellowish-white. Streak white. Tranuslucent.

Rather brittle. Hardness = 3·5 . . . 4·5. Sp. gr. = 3·032.

Compound Varieties. Massive: composition granular, individuals of various sizes, faces of composition seldom observable, rough, sometimes smooth.

1. *Analysis.*
By Du Menil.

Silica	37·00
Alumina	40·50
Oxide of iron	4·50
Lime	8·96
Soda	1·24
Water	1·00

2. Margasite has been found in a bed in primitive rocks, mixed with, and engaged in, the variety of Talc called foliated chlorite, at Sterzing in the Tyrol, where it is accompanied by foliated Fluor, and Crichtonite.

Marmatite.

A Blende from Marmato, which is black, and possessed of a lamellar structure; and contains, according to Boussingault,

Sulphuret of zinc	77·5		76·8
Proto-sulphuret of iron	22·5		23·2

Marmolite. (See *Kerolite.*)

Martite.

A variety of Octahedral Iron, which contains no protoxide of iron.

MASCAGNINE. Volatile Bitter-Salt.

Stalactitic. Massive: pulverulent.

Color yellowish-grey, white. Semi-transparent.

Taste bitter.

1. It is, apparently, a pure sulphate of ammonia; and is found in efflorescences, upon recent lava, at Etna and Vesuvius; upon decomposed lavas of Puzzuolo, in the coal measures of Aubin and Aveyron, on the surface of sandy plains near Turin, and dissolved in the lakes of Tuscany.

MEERSCHAUM. (See *Magnesite.*)

MEIONITE. (See *Scapolite.*)

MELACONITE. Cupreous Lusine-Ore.

Massive; composition impalpable; earthy and pulverulent.

1. Fusible before the blow-pipe into a black scoria, and yielding globules of copper in the reduction flame. It is soluble in nitric acid, without the disengagement of gas. According to BEUDANT, it consists of

Oxygen - - - - -	20·17
Copper - - - - -	79·83

It often contains the hydrated oxides of iron and manganese.

2. It occurs in all copper mines, and is probably derived from the decomposition of Copper Pyrites and Blue Malachite. That which is derived from the decomposition of the latter species, is nearly pure.

3. The most remarkable localities are Chessy near Lyons, Rheinbreitbach on the Rhine, Lauterbach and Zellerfeld in the Hartz, Kupferberg in Silesia, Hungary, Bannat and Cornwall.

MELANITE. (See *Garnet.*)

MELANOCHROITE.

In rhombic prisms, having two faces enlarged, so as to impart to the crystals a tabular shape.

Lustre resinous, dull. Translucent on the edges, to opake. Color hyacinth-red, to orange-red. Powder brick-red. Sp. gr. = 5·75.

Compound Varieties. Massive. Composition impalpable.

1. Before the blow-pipe, it melts easily into a brown mass, which, on cooling, assumes a crystalline structure.

2. *Analysis.*

By HERMANN.

Oxide of lead - - - -	76·36
Chromic acid - - - -	23·64

Mellite.

3. It is found at Beresofsk in the Ural, accompanied by Red Lead-Ore, Pyromorphite, Vauquelinite and Galena.

Melilite.

Primary form. Right square prism.

Secondary form. The primary, with its lateral edges truncated. Fracture imperfectly conchoidal.

Color yellow, inclining to red or green. Opake.

Hardness = 5·5 . . . 6·0. Sp. gr. = 3·041.

1. Before the blow-pipe, it melts, without ebullition, into a greenish glass. Reduced to powder, it gelatinizes with nitric acid.

2. *Analysis.*

By Carpi.

Silica	38·00
Lime	19·60
Magnesia	19·40
Alumina	0·90
Oxide of iron	12·10
Oxide of titanium	4·00
Oxide of manganese	2·00

3. It is found at Capo di Bove, and Tivoli near Rome, accompanied by Nephiline, in the fissures of a volcanic rock.

4. It will probably prove, if its hardness and specific gravity can be relied upon, to be a new species.

MELLITE. Pyramidal Melichrone-Resin. Mohs.

Primary form. Octahedron with a square base. P on P = 93°.

Secondary forms.

1. Primary, with the summits truncated.

2. The same, with the truncation of the angles of the base.

3. The same as 2, with the truncation of the upper edges of the octahedron.

Mellite.

Cleavage, parallel with P very difficult. Fracture conchoidal. Surface of the truncated summits rough and curved; of the planes on the pyramidal edges rough; the rest of the planes smooth and shining.

Lustre resinous, inclining to vitreous. Color honey-yellow, inclining often to red and brown. Streak white. Transparent . . . translucent.

Sectile. Hardness = 2·0 . . . 2·5. Sp. gr. = 1·597.

Compound Varieties. Small massive nodules: composition granular.

1. It loses color and transparency, when exposed to the flame of a candle, and is soluble in nitric acid.

2. *Analysis.*

	By KLAPROTH.	By WOHLER.
Alumina	16·00	41·4
Mellitic acid	46·00	14·5
Water	33·00	44·1

3. It is found only at Artern in Thuringia, where it exists in a bed of brown coal, sometimes attended by Sulphur.

MENACCANITE. (See *Iserine.*)

MENGITE.

Primary form. Right rhombic prism. M on M = 136° 20′.

Secondary form. Primary, with the terminal edges replaced by single planes, inclining to the lateral planes under angles of 140° 30′.

Cleavage, parallel with the secondary planes in traces. Fracture conchoidal, to uneven.

Color black.

Hardness. Scratches glass. Sp. gr. = 5·43.

It is found in Siberia.

MENILITE. (See *Opal.*)

MESOLE. (See *Mesotype.*)

MESOLITE. (See *Mesotype.*)

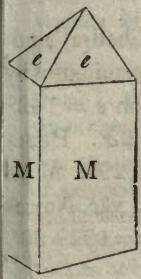
Mesotype.

MESOTYPE. Prismatic Kouphone-Spar. Mohs.

Primary form. Right rhombic prism. M on M = 91° 0′.

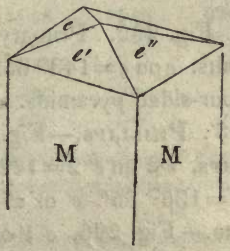
Secondary forms.

Fig. 292.



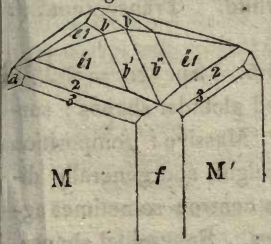
Cheshire, (Conn.)

Fig. 293.



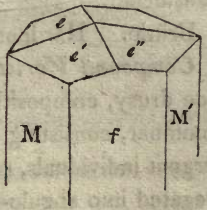
Cheshire, (Conn.)

Fig. 294.



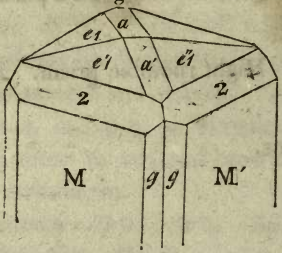
Iceland.

Fig. 295.



Mesotype.

Fig. 296.



Faroe.

Fig. 292. Primary form, surmounted by dihedral summits. e on e=143° 35.—Fig. 293. Primary, terminated by four-sided pyramids. e' on e''=143° 35′. e' on e = 142° 33′. PHILLIPS.—Fig. 294. b on b'' = 146° 23′. PHILLIPS. $e'2$ on $e''2$=142° 38′. PHILLIPS.—Fig. 295. M on f=135° 35′. e' or e'' on f=109° 18′. PHIL. var. Natrolite.—Fig. 296. $e''1$ on a=162° 15′. M on g=162° 30′. PHILLIPS.

Cleavage, parallel with M perfect. Fracture conchoidal, uneven. Surface of the replaced lateral edges, striated vertically; the rest of the faces smooth.

Lustre vitreous. Color few shades of white, generally greyish or yellowish. Streak white. Transparent . . . translucent.

Brittle. Hardness = 5·0 . . . 5·5. Sp. gr. = 2·249.

Compound Varieties. Implanted globular shapes: surface drusy, composition columnar. Massive: composition columnar, consisting of delicate, straight, and generally divergent individuals, radiating from a centre; sometimes aggregated into angulo-granular masses. Spheroidal shapes, formed in vesicular cavities.

Mesotype.

1. Before the blow-pipe, it loses its transparency, and melts into a glassy globule: the radiated varieties exfoliate, and the compact ones intumesce. They are with difficulty soluble in borax. Some of them assume by heat, faint degrees of opposite kinds of electricity on their opposite ends, and become positively electric by friction.

2. *Analysis.*

	By Gehlen & Fuchs.				By Berzelius.	By Smithson.
	var. Scolezite, from Staffa.	var. Mesolite, from Iceland.	from Hohentweil.	var. Natrolite, from Tyrol.	var. Mesole.	var. Mesolite, from Faroe.
Silica	46·75	47·46	47·21	48·63	42·60	49·0
Alumina	24·82	25·35	25·60	24·82	38·00	27·0
Soda	0·39	4·87	16·12	15·69	5·63	17·0
Lime	14·20	10·04	0·00	0·00	11·43	0·0
Water	13·64	12·41	8·88	9·60	12·70	9·6
Ox. of iron	0·00	0·00	1·35	0·21	0·00	0·0

3. The general repositories of this species are the vesicular cavities of amygdaloidal rocks. It occurs associated with Analcime, Chabasie, and Calcareous Spar.

4. The most distinguished localities are Iceland, Scotland, the Faroe Islands, the Isle of Bourbon, Auvergne and Tyrol. It also occurs abundantly in the basalt of the Giant's Causeway. The variety Natrolite, and which is of a yellowish grey color, is found in a porphyritic rock near Lake Constance; also at Klingstone near Hohentweil in Swabia. Mesotype, with the exception of one localitiy in Nova Scotia, is a rare mineral in North America. It is met with, however, in small quantities, in the trap of New England, and rarely in seams between Hornblende and Gneiss. The most interesting specimens in the first mentioned rock, occur at Cheshire, (Conn.); and in the latter, at Washington, in the same state.

Metaxite.

Massive: composition columnar, in extremely thin individuals; impalpable.

Lustre silky. Color greyish white. Translucent on the edges. Shining in the streak.

Hardness (scale of Breithaupt) = 3·0 . . . 4·0. Sp. gr. = 2·520.

Mica.

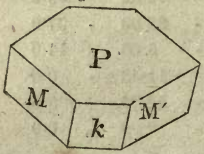
1. It is fusible before the blow-pipe, yielding moisture; with soda, it melts into a white globule; with salt of phosphorus, flocculi of silica appear. It appears, therefore, to be some earthy silicate.

MICA. Rhombohedral Talc-Mica. Mohs.

Primary form. Oblique rhombic prism. M on M′ = 120°. M on P = 98° 40′.

Secondary forms.

Fig. 297.



Acworth, (N.H.) Greenfield, (N.Y.)

Fig. 298.

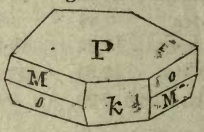


Fig. 297. P on $k = 90°$. M on $k = 120°$. P on M = 98° 40′. P on M′ = 81° 20′.—Fig. 298. P on $o = 90°$.

Cleavage, parallel with P highly perfect, and easily obtained; also traces of cleavage parallel with M M′. Fracture scarcely observable, uneven. Surface, k and M, horizontally streaked; the other faces, particularly P, smooth.

Lustre pearly, often inclining to metallic upon P: the other faces, if they are smooth enough, present a kind of lustre between vitreous and adamantine. Color various shades of grey, generally passing into green, brown, and black; also with white and red, (particularly, peach-blossom red.) Superficial tinges of pinch-beck brown. Streak white, grey. Transparent, imperfectly . . . translucent on the edges. It is less transparent in the direction of the axis, than perpendicular to it; and generally exhibits

different colors when viewed in these directions; for instance, oil-green in the first, and liver-brown in the second.

Sectile. Thin laminæ are elastic. Hardness =2·0 ... 2·5. The acute edges of the laminæ, however, will sometimes scratch Fluor. Sp. gr.=2·949, a greenish black variety, in large individuals. =2·832 of Lepidolite.

Compound Varieties. Twin-crystals; axis of revolution perpendicular, face of composition parallel to one of the faces of M. The composition is often repeated parallel to both the faces of M. The individuals rarely project beyond the face of composition. When they do not, the composition is only obvious from the intersecting striæ upon P, and from the cleavages produced. In this way the star-like crystals, of a large size, found at Acworth, (N. H.) are produced. The same composition is frequent in massive varieties, in large individuals, particularly in the large cleavage forms found at Munroe, (N.Y.) and at Mendham, in New Jersey, whose numerous cleavages are easily explained upon this supposition. Globular forms, both imbedded and implanted: surface of the latter rough; composition columnar, sometimes joining in a second curved lamellar composition. Massive: composition granular, of various sizes of individuals; or also imperfectly columnar, faces of composition irregularly streaked and rough.

1. In the present species must be included the old species Pinite, originally described from France. It appears to be only an impure, crystallized Mica, contaminated by chloritic Talc, or in some cases pure Mica, which is partially decomposed. The annexed figures represent the bases of very distinct crystals, (some of which are at least an inch in diameter,) from Lancaster, (Mass.) and from Haddam, (Conn.)

Mica.

Fig. 299.

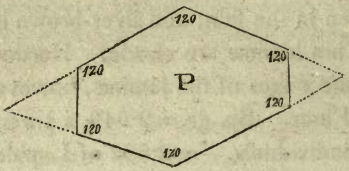


Fig. 300.

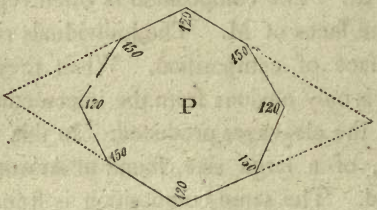
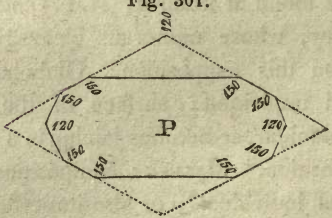


Fig. 301.



The inclination of P to the lateral planes is generally 90°; in a few cases, it is 96°, or a little above. When 90°, the planes M do not appear upon these crystals. Color dark greenish or bluish grey. Cleavage parallel with P. Fracture uneven. Sp. gr. = 2·893, of a crystal from Lancaster. Emits an argillaceous odor when moistened.

2. Before the blow-pipe, several varieties first lose their transparency, and then melt into a scoria, or into a glass, white or colored, or even black. Others are infusible, and they show in general as much difference in this respect, as in their composition.

3. *Analysis.*

Analysts.	Varieties of Mica, and localities.		Silica.	Alumina.	Magnesia.	Lime.	Lithia.	Potash.	Oxide of iron.	Oxide of mang.	Oxide of titanium.	Fluoric acid.	Water.	Total.
Peschier.		Siberia.	40·25	22·00	0·00	1·75	0·00	7·25	8·75	2·00	13.00	3·24	0·00	98·24
Klaproth.	In large foliæ.	Siberia.	48·00	34·25	0·50	0·00	0·00	8·75	4·50	trace.	0·00	0·00	0·00	96·00
	Silver white.	Zinnwald.	47·00	20·00	0·00	0·00	0·00	14·50	15·50	1·75	0·00	0·00	0·00	98·75
	Black.	Siberia.	42·50	11·50	9·00	0·00	0·00	10·00	22·00	2·00	0·00	0·00	0·00	97·00
Rose.		Fahlun.	46·22	34·52	2·11	0·00	0·00	8·22	6·04	0·00	0·00	1·09	0·98	0·00
		Utoe.	47·50	37·20	trace.	0·00	0·00	9·60	3·20 protox.	0·06	0·00	0·56	2·63	101·59
		Broddbo.	46·10	31·60	trace.	0·00	0·00	8·39	8·65 protox.	0·00	0·00	1·12	1·00	98·26
		Kimito.	46·358	36·800	trace.	0·00	0·00	9·220	4·53	0·96	0·00	0·765	1·84	99·518
Turner.	Silver-white.	Zinnwald.	40·28	24·53	trace.	0·00	4·09	9·47	11·33 protox.	1·66 protox.	0·00	5·14	0·00	100·50
	Greenish.	Altenberg.	40·19	22·72	trace.	0·00	3·06	7·49	19·78 perox.	2·02 protox.	0·00	3·99	0·00	99·75
	Grey.	Cornwall.	50·82	21·33	trace.	0·00	4·05	9·86	9·03 black.	trace	0·00	4·81	0·00	99·95
	Brown.	Cornwall.	40·06	22·90	trace.	0·00	2·00	4·30	27·06	1·79	0·00	2·71	0·00	100.87
	Yellowish-grey.	Zinnwald.	46·233	14·141	0·00	0·00	4·206	4·900	17·973	4·573	0·00	8·530	0·831	101·387
	Peachblossom-red.	Chursdorf.	52·254	28·345	0·00	0·00	4·792	6·903	0·00	3·663	0·00	5·069	trace.	101·026
Gmelin.	Lepidolite.	Rozena.	49·060	33·611	0·480	0·00	3·592	4·186	trace.	1·402	0·00	3·445 & 0·112 ph'ic acid.	4·184	100·000
	Pinite.	Auvergne.	55·964	25·480	8·760	0·00	0·00	7·890 & 0·386 soda.	5·512	0·00	0·00	0·00	1·410	100·402
Thomson.	Emerald green.	Paris (Me.)	49·380	23·668	0·00	6·134	0·061	15·292	7·312	0·00	0·00	0·00	0·00	101·847
		Brunswick, (Me.)	64·44	28·844	0·00	0·00	0·00	0·00	4·428 perox.	0·00	0·00	0·00	1·00	98·712
Wenz.	Lepidolite.		49·06	33 61	0·41	0·00	3·60	4·18	0·00	1·40	0·00	3·45	4·18	99·89
Beudant.	Silver white.	Zillerthal.	51·3	31·9	3·1	5·2	0·00	6·2	0·00	0·00	0·00	2·1	0·00	0·00

Mica.

4. Mica forms one of the constituents of various rocks, as granite, mica-slate, gneiss, porphyry, and some kinds of sandstone. They form, sometimes, more or less considerable concretions in these rocks, and contain imbedded crystals of Topaz, Tourmaline, and other species. As single crystals, they often appear imbedded in granular limestone, in basalt and wacke, and as implanted crystals, they are found upon the specimens ejected from Vesuvius. Several varieties of Mica accompany ores of tin and tungsten, in metalliferous beds.

5. Mica, in extraordinarily large individuals, is found in Siberia; at Zinnwald, in Saxony, it occurs in crystals, possessing two axes of double refraction. It is also found in the Hörlberg in Bavaria, in imbedded globules in Moravia, at Mount St. Gothard in Switzerland, at Finbo in Sweden, Pargas in Finland, at Wisenthal in Saxony, and Joachimsthal in Bohemia, imbedded in basalt and wacke. At Mount Vesuvius, crystals of Mica, with one axis, often of considerable size and transparency, occur in the drusy cavities of the ejected specimens. Lepidolite occurs near Rozena in Moravia, and at Utö in Sweden. Pinite is found, in granite, at Schneeberg in Saxony, in Auvergne and Cornwall.

The localities of Mica in the United States, are numerous and interesting. Distinct crystals, often remarkable for their size and perfection, occur at Acworth, (N. H.) in granite, implanted upon Feldspar: here also occur the twin crystals, and massive variety, in large individuals, aggregated also after the manner of the twin crystals. Very handsome crystals are found at Greenfield, near Saratoga, in the granite vein that contains Chrysoberyl, Tourmaline and Feldspar crystals: the Mica from this place is of a rich oil-green color when viewed across the axis, and reddish-brown perpendicular to it. Small but distinct crystals exist in the limestone of Orange county, (N. Y.) associated with Spinel and Brucite. Rose-colored crystals are found in the tourmaline granite of Goshen and Chesterfield, (Mass.) and in general, nearly all the deposits of Beryl throughout New England contain, occasionally, crystals of Mica. Highly perfect cleavage-crystals, of great size and of dark greenish black color, are contained in a vein about one foot in width, near the iron mines of Munroe, at Greenwood, (N. Y.) A similar variety, but partly decomposed, is found in the soil at Mendham, (N. J.) Individuals nearly a foot across, occur at Paris in Maine: these are of a rich brown color, and often penetrated by Tourmaline crystals. A yellow, somewhat copper-colored variety, massive and in six-sided tables of large size, is found at Henderson, Jefferson county, (N. Y.) A dark brown colored Mica,

Mica.

in plates of moderate size, has been met with near Moriah upon Lake Champlain: also black mica in the same region at Willsborough, and a pinchbeck-brown variety in Lower Canada. An emerald-green variety, in minute scales, disseminated through quartz, occurs at Brunswick, (Me.) Lepidolite, in beautiful varieties, exists at Paris, (Me.) where it is often penetrated, as at Rozena in Moravia, by Rubellite: in small quantities, also, at Middletown, (Conn.) under similar circumstances. Pinite is found at Lancaster, (Mass.) imbedded in Quartz, associated with Andalusite, and at Haddam, (Conn.) with Chrysoberyl, Garnet, Tourmaline, &c.

Appendix to Mica.

i. *Tautokline Aster-Mica.* Breithaupt.

Primary form. Acute rhomboid. P on P = 66° 11′ 20″.

Cleavage perfect parallel with planes, tangent to the angles of the base; with the primary faces, imperfect.

Lustre pearly. Color green, to greenish white. Having but a single optical axis. Streak greenish-white.

Flexible in thin laminæ. Hardness (scale of Breithaupt) = 2·25 . . . 2·50. Sp. gr. = 2·821 . . . 2·885.

1. The foliated chlorite from Zillerthal, and a portion of the old species Mica, belong to the present division.

ii. *Rubellan Aster-Mica.* Breithaupt.

Primary form. Acute rhomboid. P on P = 66° 19′ 50″.

Cleavage as above.

Lustre pearly. Color brownish red to reddish brown. Optical axis single. Streak the same as color.

Brittle. Hardness (scale of Breithaupt) = 2·50 . . . 3·0. Sp. gr. 2·697 . . . 2·717.

1. This mineral is found only in the Mittelgebirge in Bohemia.

iii. *Kuphone Aster-Mica.* Breithaupt.

Primary form. Acute rhomboid.

Cleavage as above.

Lustre pearly. Color green. Optical axis single. Streak greenish-grey, pale.

Flexible in thin laminæ. Hardness (scale of Breithaupt) = 2·25 . . . 2·50.

1. The Kuphone Aster-Mica occurs in serpentine, at Waldheim, Kuhschnappel and Kursdorf in Penig.

Mica.

iv. *Trappean Aster-Mica.* BREITHAUPT.

Primary form. Acute rhomboid.

Cleavage as above.

Lustre pearly. Color black to dark brown. Optical axis as above. Streak yellowish grey.

Flexible in thin laminæ. Hardness (scale of BREITHAUPT) = 2·50 . . . 3 0. Sp. gr. = 2.776.

v. *Axotomous Aster-Mica.* BREITHAUPT.

Primary form. Acute rhomboid. P on P = 67°, about.

Lustre pearly. Color greenish grey, to white. Optical axis single. Streak white.

In thin laminæ, flexible. Hardness (scale of BREITHAUPT) = 2 50. Sp. gr. = 2·780.

1. This is the variety from Munroe, (N. Y.)

vi. *Dichromatic Aster-Mica.* BREITHAUPT.

Primary form. Acute rhomboid. Inclination of P to the axis = 15° 14′ to 15° 15′.

Cleavage as above.

Lustre pearly. Color green. Green parallel with the vertical axis, hyacinth red at right angles to it.

Flexible in thin laminæ. Hardness (scale of BREITHAUPT) = 2·75.

1. From Zillerthal and from Binden in Switzerland.

vii. *Black Aster-Mica.* BREITHAUPT.

Color black. Olive-green, in very thin laminæ.

Sp. gr. = 2·507.

viii. *Lepidolite Rock-Mica.* BREITHAUPT.

Primary form. Oblique rhombic prism. M on M = 119°.

Cleavage parallel with M perfect, with the shorter diagonal only in traces.

Lustre pearly. Color pale red, to light grey. Optical axis double. Streak white.

Flexible in thin laminæ. Hardness (scale of BREITHAUPT) = 3·0. Sp. gr. = 2·827 . . . 2·855.

1. To this species, belongs the varieties of Mica, called Lepidolite, and some others.

ix. *Hemidomatic Rock-Mica.* BREITHAUPT.

Primary form. Oblique rhombic prism. M on M = 118°.

Cleavage, parallel with M, perfect; with the shorter diagonal, in traces.

Lustre metallic pearly. Color grey and brown. Optical axis double. Streak greyish white.

Flexible in thin laminæ. Hardness (scale of BREITHAUPT) = 2·0. Sp. gr. = 2·956 . . . 2·983.

1. The present species is cited from Zinnwald, Bohemia.

x. *Siderose Rock-Mica.* BREITHAUPT.

Primary form. Oblique rhombic prism.

Cleavage, perfect parallel with M.

Lustre pearly. Color dark green to black. Optical axis double. Streak green to greenish grey.

Slightly flexible in thin laminæ. Hardness (scale of BREITHAUPT) = 3·25 . . . 3·50. Sp. gr. = 3·146 . . . 3·190.

1. Locality, Altenberg, Saxony.

x. *Rhombohedral Chrysophane-Mica.* BREITHAUPT.

Primary form. Acute rhomboid.

Cleavage, the same as in Tautokline Aster-Mica.

Lustre metallic pearly. Color yellowish brown to pinch-beck brown. Optical axis single. Streak yellowish grey, almost pale.

Scarcely flexible in thin laminæ. Hardness (scale of BREITHAUPT) = 5·0 . . . 5·50. Sp. gr. = 3·071.

1. This mineral is said by BREITHAUPT, to have been sent to Europe from the United States, under the name of Clintonite, and to be found at Warwick, (N.Y.) Its locality is more probably Amity; and it appears to be the variety of Bronzite, described page 89, vol. i. of this work.

MICROLITE. Octahedral Tungstic-Baryte.

Primary form. Regular octahedron.

Microlite.

Secondary forms.

Fig. 302.

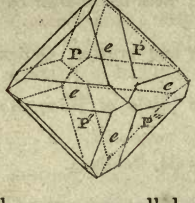
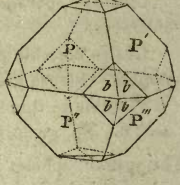


Fig. 303.



Cleavage, parallel with the primary faces, imperfect. Fracture conchoidal, passing to uneven. Surface of the primary faces, generally dull; those of *b* also.

Lustre resinous. Color straw-yellow, to dark reddish-brown. Transparent to translucent on the edges. Streak white, except when the color of the mineral is brown; it then resembles the color.

Brittle. Hardness=5·0...5·5. Sp. gr.=4·75...5·00.

1. Alone before the blow-pipe, it remains unaltered. It is slowly dissolved in the glass of borax, to which it communicates a yellow color, that grows paler on cooling, but remains transparent unless subjected to flaming, when it becomes nebulous, and presents on cooling, a pale yellow enamel. It is not readily acted upon by carbonate of soda. Insoluble in nitric acid. Its chief ingredient is probably the *oxide of cerium*.

2. It is found at Chesterfield, (Mass.) in the vein of Albite, which contains the green and red Tourmaline. The largest crystals yet seen, weigh but 0·4 of a grain. They are disseminated through the Albite, particularly near its junction with the smoky Quartz.

MIEMITE. (See *Dolomite*.)

MIKROKLIN. (See *Feldspar*.)

MIMETENE.

Primary form. Regular hexagonal prism.

Secondary form. Terminal edges replaced by single planes.

Cleavage, parallel with the primary faces, imperfect; scarcely visible parallel to the bases of the prism.

Mimetene.

Fracture imperfectly conchoidal, uneven.

Surface horizontally streaked and uneven; the prisms are often barrel-shaped, or contracted at the ends.

Lustre resinous. Color pale yellow, passing to brown. Semi-transparent . . . translucent.

Brittle. Hardness = 3·5 . . . 4·0 ? Sp. gr. = 5·0 . . . 6·4. (7·2 Kobell.)

Compound Varieties. Globular, reniform, botryoidal, fruticose shapes: massive, composition columnar, or granular.

1. Alone, on charcoal, before the blow-pipe, it melts with some difficulty, and is reduced at once to a number of globules of lead, attended with the copious disengagement of smoke, and the odor of arsenic. When a small crystal is held by the forceps in the exterior flame of the blow-pipe, the part within the flame melts, and on being allowed to cool, crystallizes like the phosphate of lead under similar circumstances.

2. *Analysis.*

	By Wohler, fr. Johangeorgenstadt.	By Gregor, fr. Cornwall.	By Bindheim, fr. Nertschink, Siberia.
Oxide of lead	75·59	69·76	35·00
Phosphoric acid	1·32	0·00	Oxide of iron 14·00
Arsenic acid	21·20	26·40	25·00
Muriatic acid	1·89	1·58	Silica 7·00
			Alumina 2·00
			Silver 1·15
			Water 10·00

The specimen analyzed from Siberia was probably impure, from the presence of hydrate of iron.

3. This mineral occurs in veins in various rocks, accompanied by Galena, Copper Pyrites, Fluor, Quartz, &c. Capillary varieties are found at St. Prix in the department of the Saone in France. In England, it occurs crystallized in a copper vein in granite, in Huel Unity, Cornwall; also in the parish of Endellion, and in the lead mines of Devonshire. The locality of Johangeorgenstadt, affords handsome crystals of a yellow color; that of Nertschinsk in Siberia, furnishes reniform masses, of a brownish red color.

4. As yet, there does not appear to be sufficient ground for distinguishing the Mimetene from Pyromorphite.

Mineral Hydro-Carbon.

In acicular crystals.

Lustre nacreous. Color white, or yellowish white. Sp. gr. = 0·65.

1. It melts at 112° F., and distils at 194°, condensing unaltered. It dissolves slowly in alcohol, but more rapidly in ether and oil of turpentine.

2. *Analysis.*

Carbon - - - - - - -	73
Hydrogen - - - - - - -	24

3. It is found between layers of lignite, near Urnach, canton of St Gall, Switzerland.

MINIUM. Molybdic Lusine-Ore.

Massive: composition impalpable, pulverulent. Color aurora-red.

Sp. gr. = 4·6.

1. In the reducing flame of the blow-pipe, globules of metallic lead are produced. It passes to the state of the brown oxide, through the action of nitric acid. It probably consists of lead 89·62, and oxygen 10·38.

2. It is only met with in very small quantities in veins of Galena, and also, associated with Calamine.

3. Its localities are Bleialf in Eifeld, Badenweiler in Baden, Brillon in Westphalia, Island of Anglesea, Grassington-Moor, and Grass-hill chapel in Yorkshire.

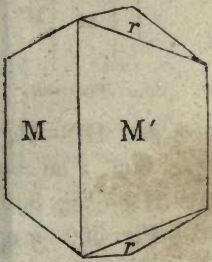
MISPICKEL. Prismatic Eruthleucone-Pyrites.

Primary form. Right rhombic prism. M on M = 111° 12′.

Mispickel.

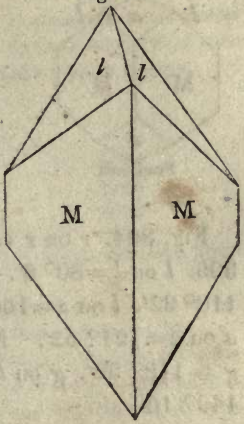
Secondary forms.

Fig. 304.



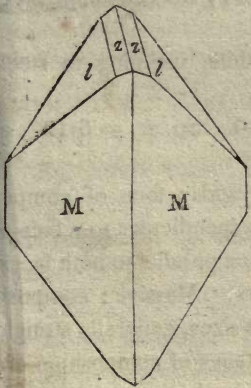
Freiberg, Saxony.
Franconia, (N. H.)

Fig. 305.



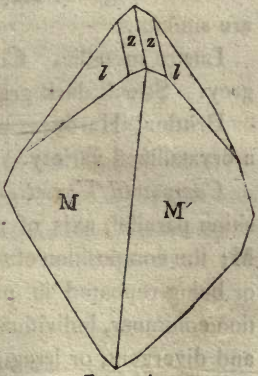
Franconia.

Fig. 306.



Franconia.

Fig. 307.



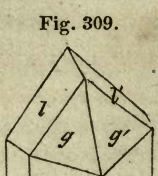
Franconia.

Mispickel.

Fig. 308.

Franconia.

Fig. 309.



Franconia.

Fig. 310.

Franconia.

Fig. 304. r on $r = 145° 26'$. (*ditétraèdre.* H.)—Fig. 305. l on $l = 80° 8'$. (*unitaire.* H.)—Fig. 306. z on $z = 118° 32'$. l on $z = 160° 49'$. (*unibinaire.* H.)—Fig. 308. a on $a = 121° 52'$. M on $a = 136° 20'$.—Fig. 309. g on $g = 118° 32'$. g on $l = 131° 48'$.—Fig. 310. g on $a = 149° 16'$.

Cleavage, parallel with M and M′ pretty perfect; traces parallel with P. Surface, r deeply streaked parallel to its own edges; g sometimes rough, or striated in the direction of its edges of combination with l; the remaining faces are smooth.

Lustre metallic. Color silver-white, inclining to steel-grey. Streak dark greyish-black.

Brittle. Hardness = 5·5 . . . 6·0. Sp. gr. = 6·127, of a crystallized variety.

Compound Varieties. Twin-crystals: face of composition parallel, axis of revolution perpendicular to a face of M; the composition often taking place parallel to both faces, or being repeated in parallel layers. Massive: composition columnar, individuals of various sizes, generally straight and divergent, or irregular. The faces of composition are irregularly streaked. Individuals joined in a granular com-

position are often very small, or even impalpable and strongly connected; the fracture is uneven.

1. Before the blow-pipe, upon charcoal, it emits copious arsenical fumes, and melts into a globule, which is nearly pure sulphuret of iron. It is soluble in nitric acid, with the exception of a whitish residue.

2. *Analysis.*

By STROMEYER.

Iron - - - - - -	36·04
Arsenic - - - - - -	42·88
Sulphur - - - - - -	21·08

Certain varieties contain a small proportion of silver, and have hence been called *Argentiferous Arsenical Iron.*

3. Mispickel is frequently met with in beds and veins. It is accompanied by ores of silver, lead and tin, and is often attended by Blende.

4. It is common in the mining districts of Saxony; in beds at Breitenbrunn and Raschau; in veins at Freiberg and Munzig, and in tin veins at Altenberg, Geyer and Ehrenfriedersdorf; also in Bohemia, Andreasberg in the Hartz, Tunaberg in Sweden, and Cornwall.

The most interesting deposit of this ore in the U. States, is at Franconia, N.H., where it occurs in gneiss, crystallized in the above forms. It is associated with Yellow Copper Pyrites. A bed of the massive variety exists at Worcester, (Mass.) A similar variety is found at Chatham, (Conn.) along with Copper Nickel; and at Monroe, (Conn.) with Wolfram, Magnetic Iron Pyrites and Native Bismuth.

MOHSITE. Uncleavable Iron-Ore.

Primary form. Rhomboid. P on P = 73° 43′.

Secondary form. Twin-crystals, flattened in a direction perpendicular to the axis, presenting the aspect of small flat tables, nearly circular, with alternate re-entering and salient angles on their edges.

Cleavage not observable.

Lustre metallic. Color iron-black. Opake.

Brittle. Hardness, scratches glass.

1. It is believed to have come from Dauphiny.

Molybdenite.

MOLYBDATE OF LEAD. (See *Yellow Lead-Ore.*)

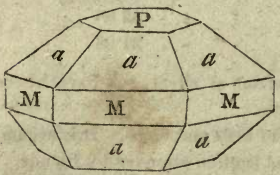
MOLYBDENA-SILVER. (See *Bornite.*)

MOLYBDENITE. Rhombohedral Polypoione-Glance.

Primary form. Regular hexagonal prism.

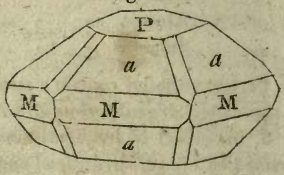
Secondary forms.

Fig. 311.



Haddam, (Conn.)

Fig. 312.



Shutesbury, (Mass.)

Fig. 311. Prmary form, with terminal edges replaced by single planes.—Fig. 312. The same, with the edges between *a* truncated.

Cleavage, parallel with P highly perfect. Fracture not observable. Surface, P smooth; the remaining planes horizontally streaked.

Lustre metallic. Color pure lead-grey. Streak unchanged. Thin laminæ are highly flexible. Very sectile. Hardness $=1{\cdot}0 \ldots 1{\cdot}5$. Sp. gr. $=4{\cdot}591$.

Compound Varieties. Massive; composition granular, of various sizes of individuals.

1. It does not melt, nor is it reduced before the blow-pipe, but it emits sulphureous fumes, which are deposited on the charcoal. It deflagrates with nitre, and is soluble with effervescence in nitric acid, leaving a grey residue.

2. *Analysis.*

By BUCHOLZ.

Molybdena	60 00
Sulphur	40·00

3. It is generally found imbedded in granite or gneiss. It is not unfrequently met with in repositories of Tin-Ore, and is accompanied also by Wolfram.

4. Among the oldest known localities of the present species, are Altenberg in Saxony, and Schlaggenwald and Zinnwald in Bohemia. In these places it occurs along with Tin-Ore; in which connexion also, it is found at Cornwall. Other foreign localities are, Norway, Sweden and Scotland.

It is of frequent occurrence in the United States, where it is generally found in gneiss. The most interesting localities are, Haddam and the adjoining towns upon the Connecticut River, where it is found in the quarries of gneiss, in crystals and large plates; at Saybrook it is associated with Stilbite. Other localities are, Shutesbury, (Mass.) and Bowdoin, (Maine.) A very powerful vein of Molybdenite has lately been found at Westmoreland, (Vt.) where it exists in granular masses of considerable size, often free from the intermixture of other minerals. Associated with it are found white crystals of Apatite.

MOLYBDIC OCHRE. Molybdic Lusine-Ore.

Massive: composition impalpable, pulverulent.

Color yellow.

1. Fusible before the blow-pipe, attended with a white smoke. Heated on charcoal, it is partially absorbed, and on powdering and washing the charcoal, grains of the reduced metal are discoverable. With salt of phosphorus, it affords a green glass. It probably consists, when pure, of oxygen 33·39, and molybdenum 66·61; but ordinarily, it contains a portion of the oxide of iron.

2. It is found only in very minute quantities, attending the Molybdenite, at nearly all its localities.

MONAZITE. Tetarto-prismatic Tungstic-Baryte.

Primary form. Doubly oblique prism, giving angles of 49° and 99°.

Lustre vitreous. Color, hyacinth or brick-red. Streak white. Translucent on the edges.

Streak flesh-red.

Hardness = 5·00. Sp. gr. = 4·924.

1. Heated to redness in a glass tube, it suffers no change. In the strongest heat of the blow-pipe, it only melts upon the edges, where it turns to a greenish yellow. Treated with soda or borax, in the reduction flame, it dissolves with effervescence into a light, yellowish, opake mass. Dissolved in the salt of phosphorus, the globule is yellow, while warm; but on cooling becomes yellowish green, and opake. From these and other experiments, it has been inferred that the Monazite is a compound of the oxide of uranium with some one or more of the earths.

2. It is found in the mountains about Ilmensjön in Siberia.

MONOPHANE.

Primary form. Right rhombic prism. M on M = 134° 46′.

Secondary form, the primary having the obtuse angles replaced by singles planes. *t* on *t* (fig. 171) = 111° 56′.

Cleavage perfect, parallel with the shorter diagonal.

Lustre pearly on the cleavage planes, vitreous on the others. Color white.

Hardness (scale of BREITHAUPT) = 6·50 . . . 7·50. Sp. gr. = 2·158 . . . 2·177.

1. Its locality is not mentioned.

MONTICELLITE.

Primary form. Right rhombic prism. M on M = 132° 34′.

Cleavage not observable.

Lustre vitreous. Color yellowish, to colorless. Transparent.

Hardness = 5·0 . . . 7·0.

1. It becomes gelatinous in muriatic acid, and is difficult to fuse before the blow-pipe.

2. It is found with Mica and Pyroxene, in limestone, among the ejected matters of Vesuvius.

MOROXITE. (See *Apatite*.)

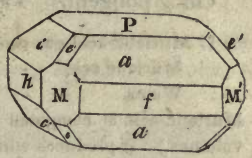
MULLERITE. Auro-tellurium Melacone-Metal.

Primary form. Right rhombic prism. M on M = 105° 30′.

Secondary form.

P on M or *f*	90°	00′
M on *f*	142	30
M on *h*	127	30
a on *f*	161	30
c on *h*	126	55
c on *a*	123	30

Fig. 313.



Imbedded crystalline laminæ. Traces of cleavage. Fracture uneven.

Lustre metallic. Color silver-white, merely inclining to brass-yellow. Opake.

Rather brittle. Soft. Sp. gr.=10·678. MULLER.

1. Before the blow-pipe, it melts into a metallic globule, and emits a pungent odor. It is soluble in nitric acid.

2. *Analysis.*
By KLAPROTH.

Tellurium	44·75
Gold	26·75
Lead	19·50
Silver	8·50
Sulphur	0·50

3. It has been found only at Nagyag in Transylvania, where it attends Graphic Gold and Manganblende.

MURCHISONITE. (See *Feldspar.*)

MURIACITE. (See *Anhydrite.*)

MURIATE OF AMMONIA. (See *Sal-Ammoniac.*)

MURIATE OF COPPER. (See *Atacamite.*)

MURIATE OF MERCURY. (See *Horn Quicksilver.*)

MURIATE OF SILVER. (See *Horn Silver.*)

MURIATE OF SODA. (See *Common Salt.*)

MURIATIC ACID. Muriatic-Acid Gas. MOHS.

Gaseous. Transparent, when unmixed with atmospheric-air.

Sp. gr. =1·278. Berz. 1·284. Mohs.
Odor pungent. Taste strongly acid.

1. Muriatic-acid gas consists of

Muriatic acid	- - - -	75·31
Water	- - - -	24·69. Berzelius: (and

Muriatic-acid is composed of chlorine and hydrogen, united in equal volumes.) It produces white fumes in the atmosphere, powerfully reddens vegetable blues, extinguishes combustion, and is fatal to life. At the temperature of 40° Fahr., water absorbs about 480 times its bulk of this gas. Under a pressure of 50 atmospheres, Faraday converted it into a colorless fluid.

2. It is found in the crevices and craters of active volcanoes, as those of Etna, Vesuvius and Hawaii. It is also said to be produced by stagnant waters in salt-mines.

3. When obtained artificially from the decomposition of common salt, it is employed as a disinfecting agent, and to form the muriate of tin. Dissolved in water, it forms the common muriatic acid of commerce, which, mingled with nitric acid, constitutes the *aqua regia*, by which gold and platinum are dissolved.

Murio-Carbonate of Lead. (See *Corneous Lead.*)

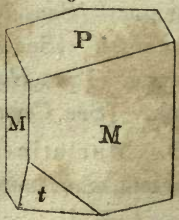
Mussite. (See *Pyroxene.*)

MYARGYRITE. Hemi-prismatic Melacone-Blende.

Primary form. Oblique rhombic prism. M on M′ = 86° 4′. P on M=101° 6′.

Secondary form.

Fig. 314.



Myargyrite.

The crystals contain many secondary faces, and have on the whole much the appearance of crystals of Copperas.

Cleavage, parallel with M, imperfect. Fracture imperfectly conchoidal. Surface, M deeply streaked parallel to the longer diagonal, P horizontally.

Lustre intermediate between metallic and metallic adamantine. Color iron-black. Streak dark cherry-red. Opake, except in thin splinters, where it transmits a deep, blood-red color.

Very sectile. Hardness = 2·0 . . . 2·5. Sp. gr. = 5·234.

1. Before the blow-pipe, it gives results nearly agreeing with those of Red Silver-Ore.

2. *Analysis.*

By Rose.

Sulphur	21·95
Antimony	39·11
Silver	36·40
Copper	1·06
Iron	0·62

3. This extremely rare mineral has hitherto been found only in a few single crystals, at Braunsdorf, near Freiberg in Saxony.

Mysorine.

Massive: composition impalpable. Fracture small conchoidal. Color brownish-black, sometimes with a tinge of green and red. Tender. Sp. gr. = 2·620.

1. It is soluble in the acids, unless when it contains foreign matters; in which case the solution deposits a reddish precipitate.

2. *Analysis.*

By Thomson.

Carbonic acid	16·70
Deutoxide of copper	60·75
Peroxide of iron	19·50
Silica	2·10

Native Amalgam.

3. It is found in the peninsula of Hindostan, near the eastern frontier of Mysore. It forms beds in the older rocks.

4. It has been observed that the Malachites, on being subjected to calcination, afford a substance analogous to the Mysorine.

NACRITE. (See *Talc.*)

NAPHTHA. (See *Bitumen.*)

NAPHTHALINE.

Crystallized in irregular, undetermined octahedra.

Cleavage, in more than one direction. Fracture conchoidal.

Lustre adamantine to resinous. Color white, green or yellow. Transparent.

Brittle. Rather heavier than water.

1. Fuses at low temperatures, and crystallizes on cooling. It readily burns with a bright flame and much smoke.

2. It is found in the fissures and fractures of bituminous wood, which it sometimes traverses, and into which it seems to have been introduced by sublimation. The layer of lignite belongs to a very recent formation, containing fossil vegetables, analogous to those now existing.

3. It is found in the coal formation of Uznach.

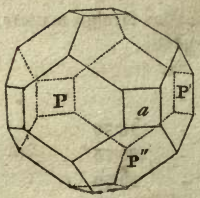
NAPOLITE. (See *Sodalite.*)

NATIVE AMALGAM. Argento-Mercury Melacone Metal.

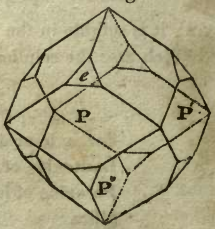
Primary form. Rhombic dodecahedron.

Secondary forms.

1. Fig. 315.



2. Fig. 316.

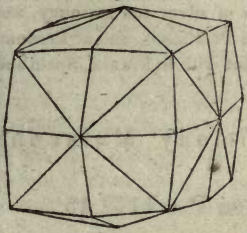


Native Amalgam.

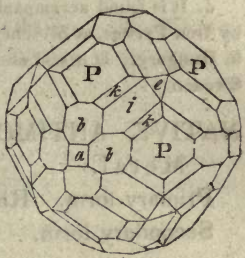
3. Regular octahedron.

4. Trapezohedron.

5. Fig. 317.



6. Fig. 318.



P on *a*	-	-	-	135° 00′	PHILLIPS.
P on *b*	-	-	-	154 00	"
P on *i*	-	-	-	150 00	"
P on *k*	-	-	-	160 40	"
a on *b*	-	-	-	161 2	"
i on *k*	-	-	-	169 5	"

Cleavage, very indistinct traces parallel to the dodecahedron. Fracture conchoidal, uneven. Surface smooth and shining.

Lustre metallic. Color silver-white. Streak unchanged.

Brittle; it emits a grating noise when cut with a knife. Hardness = 3·0 . . . 3·5. Sp. gr. = 13·755.

Compound Varieties. Massive: individuals scarcely discernible, fracture conchoidal, uneven.

1. Two kinds of Native Amalgam have been distinguished, in reference to the solid or fluid state in which it is found. The fluid varieties must be considered as solutions of the solid ones in fluid mercury.

2. Before the blow-pipe, the mercury is driven off, and a globule of pure silver is obtained.

3. *Analysis.*

	By KLAPROTH.	By CORDIER.
Silver	34·8	27·50
Mercury	65·2	72·50

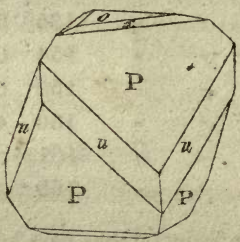
4. It is found accompanied by other ores of silver and mercury, and by Iron Pyrites, at Moschellandsberg in the Palatinate, and at Rosenau in Hungary. It is said also to have been met with in France, Spain and Sweden.

NATIVE ANTIMONY. Antimony Melacone Metal.

Primary form. Rhomboid. P on P = 117° 15′.

Secondary form.

Fig. 319.



Cleavage, parallel with *o* highly perfect, and possessing a strong lustre; parallel with P distinct, and easily obtained, but showing a less degree of lustre; parallel with *x*, obtained with difficulty, and interrupted; faint traces parallel with *u*. The surface of *o* is triangularly streaked, of P in a horizontal direction, and parallel with its edges. Fracture not observable.

Lustre metallic. Color tin-white. Streak unchanged. Rather brittle. Hardness = 3·0 . . . 3·5. Sp. gr. = 6·646, the Swedish variety.

Compound Varieties. Reniform; surface reniform or uneven; composition of flat grains collected into curved or lamellar. Massive; composition granular, of various sizes of individuals, easily separated; faces of composition striated agreeably to the faces of cleavage.

1. Before the blow-pipe, it melts quickly into a globule, and continues to burn when heated to redness, even if the blast is suspended. It emits copious white fumes, which are deposited round the globule: first yellowish-white octahedrons, probably of antimonious acid, are formed, and then snow-white prismatic crystals of oxide of antimony, with which at last, the whole globule is covered. Some of the varieties leave a globule of silver when the contents of antimony have been entirely volatilized. It crystallizes readily from fusion.

2. *Analysis.*

By KLAPROTH.

Antimony	98·00
Silver	1·00
Iron	0·25

3. Native Antimony is found in veins traversing ancient rocks, and is principally accompanied by other species that contain antimony. The *Antimony Ochre*, which occurs with it, seems to be the product of its decomposition.

4. The present species was first discovered at Suhlberg, near Sahla in Sweden, and afterwards at Allemont in Dauphiny, where it occurs in curved lamellar compound varieties, which consist of granular ones, and at Andreasberg in the Hartz. It is likewise found in primitive mountains, attended by Grey Antimony and Galena; at San Han Huetamo, and Cuencamé, in Mexico.

NATIVE ARSENIC. Arsenic Melacone-Metal.

Primary form. Rhomboid. P on P = 114° 26′.

Cleavage, imperfect, parallel with P.

Lustre metallic. Color tin-white, a little inclining to lead-grey, very soon tarnished dark-grey on being exposed to the air. Streak unchanged, rather shining.

Brittle. Hardness = 3·5. Sp. gr. = 5·766, a Saxon variety.

Compound Varieties. Reticulated, reniform and stalactitic shapes; composition granular, small and often impalpable; it is sometimes columnar, forming a second curved lamellar composition; the individuals being generally impalpable, and the faces of the second composition reniform or uneven. In columnar particles of composition, a cleavage in a direction perpendicular to the axis of the individuals, is observed.

1. Upon ignited charcoal, or before the blow-pipe, it emits a strong garlic smell, and copious white fumes; and at last disappears altogether. It is the volatilized metal, and not the white fumes of arsenious acid, which possess the odor of garlic.

2. *Analysis.*

By JOHN.

Arsenic	96·00		97·00
Antimony	3·00		2·00
Oxide of iron and water	1·00		1·00

3. It is not uncommon in several of the mines of Annaberg, Schneeberg, Marienberg and Freiberg in Saxony; also at Joachimsthal in Bohemia, at Andreasberg in the Hartz, in the Black Forest, in Alsace at Allemont in Dauphiny, at Kongsberg in Norway, at Kapnik in Transylvania, and in beds at Orawitza in the Bannat of Temeswar.

4. It is variously employed in metallurgical processes; it enters into the composition of certain kinds of glass, and of many colors, and has been introduced even among the pharmaceutical preparations. It is a violent poison.

NATIVE BISMUTH. Bismuth Melacone-Metal.

Primary form. Regular octahedron.

Secondary form. Rhombic dodecahedron.

Native Bismuth—Native Copper.

Cleavage, octahedral, perfect. Fracture not observable. Surface rough, often covered with Bismuth-Ochre.

Lustre metallic. Color silver-white, much inclined to red, subject to tarnish. Streak unchanged.

Sectile, almost malleable. Hardness=2·0 . . . 2·5. Sp. gr.=9·737.

Compound Varieties. Imbedded, feathery and arborescent shapes. Massive : composition granular, individuals very distinct, though small.

1. When heated before the blow-pipe, it is volatilized, and leaves a yellow coating upon the charcoal. It is soluble in nitric acid, but the solution yields a white precipitate, if farther diluted. It crystallizes in cubes from fusion.

2. It commonly occurs in veins in gneiss and clay-slate, and is accompanied by ores of silver, cobalt, tin, &c.

3. Its chief localities are several of the Saxon and Bohemian silver and cobalt mines at Schneeberg, Annaberg, Marienberg, Johanngeorgenstadt, Joachimsthal, &c. It occurs at Fahlun in Sweden, Modum in Norway, in France and England.

Its only known locality in the U. States, is Monroe, (Conn.) where it occurs in a bed of Quartz, associated with Wolfram, Tungsten, Galena, Blende, &c.

NATIVE COPPER. Copper Melacone-Metal.

Primary form. Cube.

Secondary forms.

1.
Primary form, with angles truncated.
Cornwall.

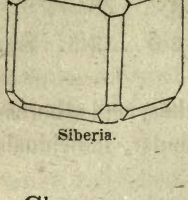
2.
Octahedron.
Cornwall.

3.
Cube, with edges truncated.
Siberia.

4.
Dodecahedron.
Cornwall.

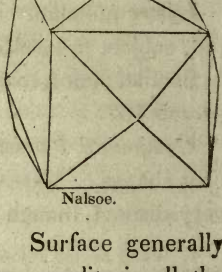
Native Copper.

5. Fig. 320.



Siberia.

6. Fig. 321.



Nalsoe.

Cleavage, none. Fracture hackly. Surface generally not very smooth, but nearly of the same quality in all the forms, excepting the dodecahedron, which is sometimes streaked parallel to its edges of combination with the cube. It is subject to tarnish.

Lustre metallic. Color copper-red. Streak unchanged, shining.

Ductile. Hardness = 2·5 . . . 3·0. Sp. gr. = 8·5844.

Compound Varieties. Twin-crystals very frequent, composed parallel to a face of the octahedron. If the form of the individuals is the icositetrahedron, and the compound crystal flattened in the direction of the axis of revolution, isosceles six-sided pyramids are formed, which at first sight appear incapable of derivation from the cube. Small crystals aggregated in rows; arborescent and filiform shapes. Massive: composition not recognizable. Plates, often consisting of distinct crystals. Superficial.

1. Before the blow-pipe, it melts pretty easily, but on cooling is covered with an oxidized coat. It is easily soluble in nitric acid, and yields under the influence of light and air, a blue solution in ammonia. It crystallizes from fusion. Dentiform and capillary crystals are often produced in the vesicular cavities of copper slags.

2. It is found in beds and veins, and is associated with various other ores of copper, and sometimes with ores of iron; also loose in the soil, and in water-worn fragments.

3. Native Copper has been more frequently met with, than any of the other metals in their native state. It occurs in beds at Herrengrund, Schmölnitz, and Göllrietz; also at Moldawa, Saska and Orawitza, in the Bannat of Temeswar; probably in the same manner in Siberia, from whence the largest and most distinct crystals of the general shape of the cube have been brought, engaged in granular limestone. It occurs likewise in beds, in bituminous marl-slate, at Camsdorf in Thuringia, and in the county of Mansfield, and in Chessy near Lyons. In veins, it is met with in considerable quantities, in many of the mines near Redruth in Cornwall. Native Copper, crystallized in beautiful icositetrahedrons, occurs in amygdoloid, accompanied by Chabasie, in Nelsoe, one of the Faroe islands. Native Copper has often been found in detached masses, throughout North America, particularly in Illinois, Michigan, and the North Western Territory. About thirty miles south from Lake Superior, on the west bank of the river Ontanawgaw, exists a serpentine rock, thickly interspersed with this species.* It has particularly abounded throughout the greenstone trap and red sandstone formation of Massachusetts, Connecticut and New Jersey; having been found at Schuyler's mine, (N.Jersey,) at Bristol, near New Haven, (Conn.) and at Deerfield, (Mass.)

What has been called *copper of cementation*, is the metal precipitated from its solution in sulphuric acid by metallic iron. It is produced at Herrengrund and Schmölnitz in Hungary, and in Cornwall.

4. Copper, in its uses, is too well known to require an enumeration of them.

NATIVE GOLD. Gold Melacone-Metal.

Primary form. Regular octahedron.

Secondary forms.

1.	2.
Primary, with angles truncated.	Cube.
Matto Grosso, Brazil.	Transylvania.

* The cabinet of Yale College contains a piece from this river, which weighs 137 pounds. A single mass, believed to weigh a ton, still occupies the bed of the river.

Native Gold.

3.

Cube, with edges truncated.

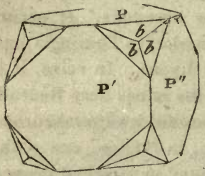
Siberia.

4.

Dodecahedron.

Transylvania.

5. Fig. 322.



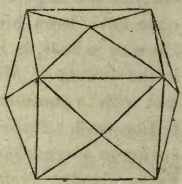
Siebenburgen.

6.

Trapezohedron.

Siebenburgen.

7. Fig. 323.



Siberia.

Cleavage, none. Fracture hackly; the cube often hollow; the octahedrons either rough or smooth, in combinations, generally the latter; the icositetrahedrons streaked parallel to the edges of combination with the cube and the octahedron. These differences in most cases are not distinctly marked.

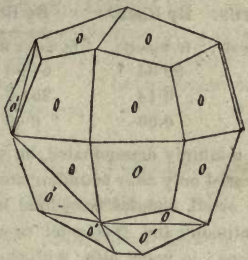
Lustre metallic. Color, various shades of gold-yellow. Streak shining.

Ductile. Hardness = 2·5 . . . 3·0. Sp. gr. = 14·857, a rolled mass of a high gold-yellow color; 19·2527, melted, Hauy.

Compound Varieties. Twin-crystals; face of composition parallel, axis of revolution perpendicular, to a face of the octahedron; pretty frequent, particularly in the icositetrahedrons, as represented in

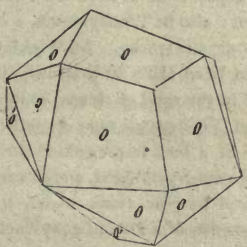
Native Gold.

Fig. 324.



If this variety be compressed in the direction of the axis of revolution,

Fig. 325



is formed. Filiform, capillary, reticulated, and arborescent shapes; also leaves and membranes. Sometimes the individuals are still discernible. Surface drusy, striated or smooth. Massive: composition not observable, fracture hackly. Plates, superficial coatings, rolled masses.

1. Native Gold melts pretty easily, and is soluble only in chlorine, or nitro-muriatic acid. Gold may be obtained crystallized, from fusion. A solution of muriate of gold in sulphuric ether, yields cubic crystals on evaporation. Brilliant crystals of the compound form of the cube, octahedron and dodecahedron, have been accidentally formed by exposing for several years an amalgam of gold wrapt up in cotton.

Native Gold.

2. *Analysis.*

	By Lampadius.	By Rose.	By Boussingault.	
	A brass-yellow colored variety.	fr. Siberia.	fr. Santa Rosa.	fr. Trinidad.
Gold	96·60	99·34	64·93	82·40
Silver	2·00	0·14	35.07	17·60
Iron	1·10	0.00	0·00	0·00

3. Native Gold is so minutely disseminated in several rocks, that its presence can be discovered only after pounding and washing. It occurs frequently in beds, in small nodules imbedded in Quartz, along with Iron Pyrites, Grey Antimony and Wolfram: rarely also, it is found in crystals in these situations: in veins also, with the same minerals, and with Blende, Calcareous Spar, Native Silver, &c. Native Gold is often found in the sand of rivers, in valleys and plains, into which it has been carried from its original repositories, in the shape of larger or smaller, generally, flat pebbles, often mixed with Quartz.

The most extensive deposits of Native Gold occur in alluvial soil in Brazil, Mexico and Peru: also in Transylvania, a considerable quantity of gold is obtained from stream-works. At Wicklow in Ireland, and in Perthshire, and near the Lead Hills in Scotland, in several districts of Germany, gold is found in the sand of rivers, or in alluvial deposits from them. The mountain of Vörospatak near Alrudbanya in Transylvania, is a remarkable instance of a rock impregnated throughout with a small portion of gold, which occurs crystallized, and in various imitative shapes, in the numerous short and narrow veins which traverse it in all directions. This mountain consists of a kind of greywacke and porphyry. In a similar rock it is found at Salzburg, and many other places along the chain of the Alps, and in the Schlangenberg in Siberia. At Offenbanya in Lower Hungary, it is accompanied by Grey Antimony; and at Zalathna and Nagyag, by Native Tellurium.

Native Gold, unknown within the U. States, until within a very few years, has now been traced from the Chaudière river in Lower Canada, to the southern boundary of the Cherokee nation in Georgia; and it is known to exist in a nearly unbroken line, from the Rappahannock in Virginia, to the Coosa in Alabama. The most important mines in this extensive range, are those situated in the Carolinas and Georgia. The mines of North Carolina are chiefly wrought in the three ranges of counties between Frederic and Charlotte, which lie in a direction about N. E. and S.W., corresponding with the general line of the coast. The Mecklenburg mines are the most valuable, and are for the most part

vein deposits; those of Burke, Lincoln, and Rutherford, are mostly alluvial mines. A single mass of Native Gold was found in Cabarras county that weighed twenty-eight pounds.* Several vein mines in the neighborhood of Fredericksburg, (Va.) have afforded fine specimens of Native Gold, traversing white Quartz.

NATIVE IRIDIUM. Iridium Sclerone-Metal.

Primary form. Rhomboid.

Secondary form. Six-sided prism, combined with two isosceles six-sided pyramids.

Cleavage, perpendicular to the axis. Grains.

Lustre metallic. Color pale steel-grey. Opake.

Brittle. Harder than Platina. Sp. gr. =19·5. WOLLASTON.

1. If melted with nitre, it becomes black; but again acquires both its color and lustre, if heated with charcoal. It is not dissolved by nitro-muriatic acid. It is an alloy of iridium and osmium.

2. It occurs in South America, accompanied with Native Platina.

NATIVE IRON. Iron Sclerone-Metal.

Primary form. Regular octahedron.

Cleavage, visible, parallel with the primary form, the crystal being traversed by natural joints, separating it into laminæ, which project and recede, so as to leave oblique angled cavities of greater or less extent on all the faces. The crystal is partially oxidated upon the outside, and between the laminæ. Fracture hackly.

Lustre metallic. Color iron-grey. Streak shining. Strong action on the magnet.

* The stream-mines of the U. States, have yielded about $6,000,000. Three deposit mines in Georgia have afforded $500,000.

Native Iron.

Ductile. Hardness=4·5. Sp. gr. =7·318, a partially oxidated fragment of the crystal from Guilford co. (N. C.)

Compound Varieties. Massive: composition not observable, excepting where it is traversed by Plumbago; in which case it separates into irregular, oblique tetrahedrons. Sp. gr.=6·72, much intermingled with Plumbago, from Canaan, (Conn.)

1. *Analysis.*

	By KLAPROTH. fr. Ramsdorf.	By GODON DE ST. MEMIN. fr. La Bowiche.	By SHEPARD. fr. Canaan.
Iron	92·50	94·50	91·80
Lead	6·00	0 00	0·00
Copper	1·50	0 00	0 00
Carbon	0·00	4·00 mechanically mixed	7·00
Phosphoric acid	0·00	1·20	0·00

2. It is not perfectly certain that the Native Iron of Kamsdorf, in Saxony, is of terrestrial origin, though it is said to have occurred in a mass of Limonite, associated with Spathic Iron and Heavy Spar. Other localities mentioned in Saxony, are Steinbach and Eibestock; at the former it is attended by brown Garnet, and at the latter, it is in a vein. A stalactitic mass, covered by fibrous Limonite and Quartz, was met with in a vein traversing the mountain of gneiss called Oulle, near Grenoble in France. The *Native Steel*, from La Bowiche in France, engaged in an iron slag, appears to be of a secondary formation, owing to the combustion of a coal seam.

The United States have afforded examples of Native Iron, of the most incontestibly terrestrial origin. The variety from Canaan, (Conn.) was found attached in the form of a vein or plate, two inches thick, to a mass of mica-slate rock, upon a primitive mountain; that from Guildford co. (North Carolina) consists of a single octahedral crystal, weighing about seven ounces, which is reported to have been detached from a mass that weighed twenty-eight pounds, and which was wrought into nails, by a black-smith.*

* The American specimens of Native Iron, here alluded to, are in the cabinet of Yale College.

3. Native Iron, alloyed with Nickel and other metals, forms large meteoric masses, and enters into the composition of meteoric stones. But as these bodies are regarded as extra-terrestrial in their origin, it will not be proper to describe them in the present work.

NATIVE LEAD. Lead Melacone-Metal.

Massive. Fracture hackly.

Lustre metallic. Color pure lead-grey. Streak shining. Malleable and ductile. Hardness = 1·5. Sp. gr. = 11·3523. Disagreeable odor by friction.

1. Before the blow-pipe, it melts easily, and is gradually dissipated in fumes, leaving a yellow powder upon the charcoal.

2. The localities generally quoted of this species, afford it under circumstances, rendering it highly probable that it has been reduced from Galena by heat. Thus, at the island of Madeira it is imbedded in vesicular masses, considered as slags by some, and a volcanic rock by others; and at Alston in Cumberland, associated with Galena Quartz, Minium, and a fused mass resembling slag. But an undoubted deposit of Native Lead exists in Michigan, at Anglaise river, where it occurs in extremely delicate membranes, between the cleavages of galena; existing, however, only in sufficient quantity to increase the sp. gr. of the Galena to 7·83.

NATIVE MAGNESIA. Rhombohedral Gypsum-Mica.

Primary form. Rhomboid.

Secondary form. Low six-sided prisms, rare.

Massive: composition lamellar, broad columnar, the latter sometimes stellular.

Cleavage, in one direction perfect.

Lustre pearly upon the cleavage face. Color white, inclining to green, grey and blue. Streak white. Translucent, sometimes only on the edges. Some varieties lose their transparency on being exposed to the air.

Sectile. Thin laminæ flexible. Hardness=1·0...1·5. Sp. gr.=2·350, the variety from Unst.

1. Before the blow-pipe, it loses its transparency and weight, and becomes friable. In acids, it is dissolved with effervescence.

2. *Analysis.*

	By Bruce.	By Fyfe.
Magnesia	70·00	69·75
Water	30·00	30·25

3. It occurs at Swinaness, one of the Shetland Islands, in small seams, in serpentine; but more abundantly at Hoboken, (N. J.) opposite New York city; the veins at this place are sometimes one inch in thickness.

NATIVE MERCURY. Mercury Melacone-Metal.

Amorphous. Liquid.

Lustre metallic. Color tin-white.

Hardness=0·0. Sp. gr.=13·581. Hauy.

1. Fluid mercury is the pure metal, as produced by nature. It is entirely volatile before the blow-pipe, and easily soluble in nitric acid.

2. Like Native Amalgam, it occurs with Cinnabar in the shape of small globules or drops, and sometimes in narrow fissures of those rocks which contain the Cinnabar.

3. The most important and well known localities of Native Mercury, are Idria in Carniola, and Almaden in Spain. In smaller quantities, it is found at Wolfstein and Mörsfeld in the Palatinate, also in some places in Carinthia, in Hungary, in Peru, and other countries.

4. The quantity of Mercury found native is too small, to allow of its being applied to any useful purpose.

NATIVE PALLADIUM. Palladium Sclerone-Metal.

Primary form. Regular octahedron.

Grains.

Lustre metallic. Color steel-grey, inclining to silver white.

Native Palladium—Native Platina.

Hardness = 4·5 . . . 5·0. Sp. gr. = 11·8, WOLLASTON; = 12·14, LOWRY.

1. It is reducible by heat. Alone, before the blow-pipe, it is infusible; but with sulphur, it melts. With nitric acid, it yields a red solution.

It consists essentially of palladium, but contains also a small proportion of iridium and platina.

It occurs intermingled with Native Platina, in Brazil.

NATIVE PLATINA. Platina Sclerone-Metal.

Primary form. Cube.

Irregular forms and grains. Surface uneven, sometimes worn off by attrition, (pebbles.)

Cleavage, none. Fracture hackly.

Lustre metallic. Color perfect steel-grey. Streak unchanged, shining.

Ductile. Hardness = 4·0 . . . 4·5. Sp. gr. = 17·332, rolled masses.

1. It is very refractory, and soluble only in nitro-muriatic acid.

2. *Analysis.*

By BERZELIUS.

	fr. Nischne-Taguilsk.	fr. Goroblagodat.	fr. the Ural.
Platina	78·94 . 73·58	86·50	84 30
Iridium	4·77 . 2·35	0·00	1·46
Rhodium	0·86 . 1·15	1·15	3·46
Palladium	0 28 . 0·30	1·10	1·06
Iron	11·04 . 12·98	8·32	5 31
Copper	0·70 . 5 20	0·45	0·74
Osmium and iridium	1·96 } . 2·30	{ 1·40	1·03 osmium.
Earthy substances	0·00 }	{ 0 00	0·72

3. The original repositories of Native Platina are not known, it having hitherto been found only in pebbles and grains, generally small, but sometimes upwards of a pound and a half in weight. It is accompanied by Zircon and some other gems; also by Magnetic Iron, Native Gold, and Native Iridium and Palladium.

4. It has been chiefly brought from the provinces of Choco and Barbacoas in South America, also from Matto-Grosso in Brazil. It has also been found in St. Domingo, and in Siberia. In the mine of Nischne-Taguilsk, (which is also rich in gold, Irid-osmium, Rutile, and even contains Diamonds,) several large masses of Native Platina have been found, weighing from seven to fifteen pounds. M. Schwetzaw describes two varieties in the Russian Platina from Nijnotaguilsk in the government of Perme. 1. *Common Platina.* Color platina-grey. Grains angular and bristled, seldom blunt edged; also in cubical crystals and grouped. Hardness = Hornblende. Malleable. Sp. gr. = 17... 17·62. *Ferruginous Platina.* Color darker than the preceding. Surface tarnished, sometimes like meteoric iron. Grains and crystals have the same form as common Native Platina. Hardness = Feldspar, and rather higher. Less malleable than the first. Sp. gr. = 14·6... 15·7. It is magnetic, and in some grains not only attracts, but repels. It contains a large proportion of iron.

5. The refractory powers of this metal, and the circumstance that it is not acted upon by the greater part of the chemical re-agents, render it extremely valuable in the construction of philosophical and chemical apparatus. It is used also for covering other metals, for painting on porcelain, for coin, and like gold and silver, for various other purposes.

NATIVE SILVER. Silver Melacone-Metal.

Primary form. Cube.

Secondary forms.

1. Cube, with angles truncated.
2. Regular octahedron. Mexico.
3. Trapezohedron. Kongsberg.

Cleavage, none. Fracture, hackly. Surface, the octahedron striated in a triangular direction, parallel to its edges of combination with the cube. The remaining faces often rough, but even.

Lustre metallic. Color silver-white, more or less subject to tarnish. Streak shining.

Native Silver.

Ductile. Hardness $=2\cdot5 \ldots 3\cdot0$. Sp. gr. $=10\cdot4743$, Hauy.

Compound Varieties. Twin-crystals; compound, parallel to one of the faces of the octahedron. Dentiform, filiform and capillary shapes, also reticulated, arborescent and in plates. Often the individuals are still discernible, but frequently also their extent can be no longer ascertained. In the latter case, the surface of the dentiform and filiform shapes is longitudinally streaked. Massive: composition rarely observable, fracture hackly. Plates formed in fissures, also superficial coatings.

1. Native Silver has been divided into *common* and *auriferous* Native Silver. It is at present impossible to decide, whether the latter ought to be united as a variety with the former, or whether it forms a species of its own, as we are not yet sufficiently acquainted with all its physical properties, by which alone this question can be decided. Specific gravity, and the yellowish color, form the distinctive marks between them; but as these may arise from the mere juxtaposition of the two metals, they are not alone sufficient for the purpose.

2. Native Silver is soluble in cold nitric acid, but in the sulphuric acid, only with the assistance of heat. It crystallizes from fusion before the blow-pipe, if the globule is not too large,—forming while crystallizing, a single individual, in which the faces of the octahedron, the cube and the dodecahedron, are distinctly seen.

3. *Analysis.*

The common varieties present the silver pure as produced by nature, occasionally alloyed with a small proportion of antimony, arsenic, iron, &c. A variety of auriferous Native Silver yielded to Klaproth, and another to Fordyce, the following ingredients:

Silver	36·00		72·00
Gold	54·00		28·00

4. Native Silver occurs principally in veins, traversing gneiss, clay-slate, and other primitive and transition rocks. It is accompanied by numerous species of Pyrites, Glance and Blende, as well as by Quartz, Calcareous Spar, &c. The auriferous Native Silver, though it is found

in the same repositories, is far more scarce. The formation of *Black Silver*, a black, friable substance, which is very rich in silver, seems to depend chiefly upon the presence of Native Silver.

5. Native Silver is found in the mining districts of Saxony and Bohemia, also in Norway and Siberia, but particularly in Mexico and Peru. Native Silver is also found in Cornwall and in Siberia. No well authenticated locality exists in the U. States.

6. The employment of silver in coinage, and in the manufacture of plate and articles of luxury, is well known.

NATIVE TELLURIUM. Tellurium Melacone-Metal.

Primary form. Rhomboid. P on P = 115° 12′.

Secondary form. Hexagonal prism, with the terminal edges replaced by single planes, the secondary planes inclining to the lateral faces at 147° 36′.

Cleavage, parallel with the primary form, but very obscure.

Lustre metallic. Color tin-white. Streak unchanged. Rather brittle. Hardness = 2·0 . . . 2·5. Sp. gr. = 6·115. KLAPROTH.

Compound Varieties. Massive: composition distinctly granular, individuals small; sometimes a tendency to columnar composition.

1. It melts upon charcoal with ease before the blow-pipe, burning with a greenish flame, and emitting the odor of horse-radish, which however is owing to the presence of a small quantity of selenium.

2. *Analysis.*

By KLAPROTH.

Tellurium	92·55
Iron	7·00
Gold	0·25

3. The Native Tellurium occurs in sandstone, probably in beds, or in veins of a contemporaneous origin with the rock. It is accompanied by Quartz and Iron Pyrites, as well as by Native Gold.

Natron.

4. It has been found in the mine of Maria Loretto at Faceberg, near Zalathna in Transylvania. It was melted to extract the gold, but has now become very scarce.

NATROLITE. (See *Mesotype.*)

NATRON. Hemi-prismatic Natron-Salt. MOHS.

In imitative shapes: composition columnar. Massive: composition granular. Commonly occurring in the state of powder, or efflorescent crusts.

Lustre vitreous on the fresh fracture. Color white, the grey and yellow tints are owing to foreign admixtures. Streak white. Semi-transparent.

Sectile. Hardness $=1{\cdot}0 \ldots 1{\cdot}5$. Sp. gr. $=1{\cdot}423$.

Taste pungent, alkaline.

1. It is very soluble in water, effloresces with acids, and melts before the blow-pipe. Blue vegetable colors are changed by it to green.

2. *Analysis.*
By BEUDANT.

	from Debreezen.	from Egypt.
Carbonic acid	30·40	30 90
Soda	43·20	43·80
Water	13·80	13·50
Sulphate of soda	10·40	7·30
Chloride of sodium	2·20	3·10
Earthy matter	0·00	1·40

3. This salt loses its water on being exposed to a dry atmosphere, and is therefore commonly met with in the state of an efflorescent powder on the surface of the earth, on the shores of lakes, or in natural caverns. It is held in solution by certain mineral waters. According to BERTHOLET, it is formed in part by a decomposition of common salt by carbonate of lime.

4. It occurs in considerable quantities in the plains of Debreezen, in Hungary; also in Bohemia, Italy and several other European countries, but principally in the soda lakes of Egypt, and in some parts of Asia and South America.

Nemalite.

5. Its chief employment is in the manufacture of soap. It enters also into the composition of glass, and is used in dyeing, washing, bleaching, &c., both in the natural state, and purified by the assistance of chemical processes.

NATROSIDERITE. (See *Achmite.*)

NECRONITE. (See *Feldspar.*)

NEEDLE-ORE. (See *CupreousBismuth.*)

NEEDLE-STONE. (See *Mesotype.*)

NEMALITE. Nemaline Atelene Picrosmine.

Massive; composition thin columnar; fibres parallel, slightly curved.

Lustre pearly. Color greyish, and bluish white. Translucent.

Fibres elastic. Hardness = 2·0 . . . 2·5. Sp. gr. = 2·30 . . . 2·44.

1. The fibres, when held in the flame of a lamp, become opake and rigid; and on being subjected to the heat of the blow-pipe, they become friable, at the same time changing to a light brown color. Soluble in acids, without effervescence.

2. *Analysis.*
By THOMSON.

Magnesia	51·721
Silica	12·568
Peroxide of iron	5·874
Water	29·666

3. It occurs in veins, traversing serpentine, at Hoboken, (N. J.)

NEOPLASE. (See *Botryogene.*)

NEOTESENE.

Primary form. Right square prism ?
Color green.

1. It yields moisture on being heated, and passes to a yellow color In a higher temperature, it scarcely gives any odor of arsenic. It im-

parts to the fluxes the color of the oxides of iron, affording at the same time a strong smell of arsenic.

2. *Analysis.*

By BERZELIUS.

Arsenic acid - - - - -	50·80
Peroxide of iron - - - -	23·00
Protoxide of iron - - - -	10·33
Water - - - - -	15·87

3. It is found in Brazil, near Villa-Rica, where it exists in cavities of Limonite.

4. It is doubtful whether this mineral can with propriety be distinguished from Cube-Ore.

NEPHELINE. Rhombohedral Feldspar. MOHS.

Primary form. Regular hexagonal prism.

Secondary forms.

Fig. 326.

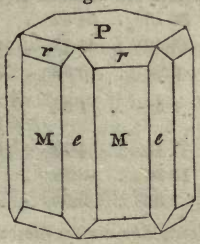
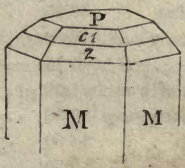


Fig. 327.



P on c 1 - - -	151° 53′	HAUY.
P on c 2 - - -	135 40	PHILLIPS.

Cleavage, parallel with M and P, both imperfect.

Fracture conchoidal. Surface smooth and even.

Lustre vitreous to resinous. Color white. Streak white. Transparent . . . translucent.

Brittle. Hardness = 6·0. Sp. gr. = 2·56.

Compound Varieties. Massive: composition granular, of various sizes of individuals. Faces of composition

rather rough. The variety Elaolite possesses a dark-blue color, passing into green, grey and brown.

1. The old species *Elaolite* appears to be, with justice, incorporated with Nepheline, on account of their resemblance in hardness and specific gravity. The *Cavolinite* and *Davyne*, also, fall within the present species, differing from it only in a somewhat diminished specific gravity, and in the surface of the crystals. The sp. gr. of the former is 2·1: its crystals are opake, and possessed of a pearly lustre,—that of the latter = 2·25 . . . 2·3, with surfaces of crystals which are dull.

2. Before the blowpipe, upon charcoal, its edges are rounded off. It yields a colorless vesicular glass, but cannot be melted into a perfect globule. Fragments of it, thrown into nitric acid, lose their transparency, and assume a nebulous appearance.

3. *Analysis.*

	By Klaproth.	By Vauquelin.	By Gmelin.		By Carpi.
	var. Elaolite.	from Monte Somma.	var. Nepheline.	var. Elaolite.	from Capo di Bove.
Alumina	30·25	49·00	33·49	34·42	9 00
Silica	46·50	46·00	43·36	44·19	40·20
Lime	0·75	2·00	0·90	0·52	20·80
Oxide of iron	1·00	1·00	1·50	1 34	1·10
Ox. manganese	0·00	0·00			12·60
Potash	18·00	0·00	7·13	4·73	12·00
Soda	0·00	0·00	13·36	16·88	0·00
Water	2·00	0·00	1·39	0·00	0·00

4. The crystallized variety occurs at Monte Somma, in the cavities of limestone rocks, ejected by Vesuvius, along with Idocrase, Garnet and Mica. It has also been found in narrow veins, traversing a kind of basalt or lava at Capo di Bove, near Rome, sometimes associated with Pyroxene. The Cavolinite and Davyne are found in the lavas of Vesuvius. The massive variety, or Elaolite, occurs near Laurig, Stavern and Frederiksvärn in Norway, imbedded in sienite, with Zircon and Sphene.

NEPHRITE. Uncleavable Petaline-Spar.

Massive: composition impalpable. Fracture coarse splintery; in some varieties slaty in the great.

Color green, particularly leek-green; rarely with a shade of blue, and still more so, with red, passing into grey and white. Translucent . . . translucent on the edges.

Very tough. Hardness = 6·0 . . . 7·0. Sp. gr. = 2·932 . . . 3·024.

1. Alone before the blowpipe, it is infusible, but becomes white.

2. *Analysis.*

	By KASTNER.		By BOWEN. from Smithfield, (R. I.)
Silica - - -	50·50	- -	44·688
Magnesia - - -	31·00	- -	34·631
Alumina - - -	10·00	- -	·562
Oxide of iron - - -	5·50	- -	1·747
Oxide of chrome - -	0 05	Lime -	4·250
Water - - -	2·75	- -	13·417

The excess of volatile matter in the variety from Smithfield is probably owing to its intermixture with Calcareous Spar, in which it is imbedded.

3. It is brought from China and Egypt. A large block was found in the alluvial soil of the alum-earth mines at Schwemmsal in Saxony.

A very handsome sky-blue variety is found in the white primitive limestone of Smithfield, (R. I.) and a greenish and reddish-grey variety, under similar circumstances, at Easton, (Penn.)

NICKEL GLANCE. Euotomous Eruthleucone-Pyrites.

Primary form. Cube.

Secondary form. Cube, with angles truncated.

Cleavage, highly perfect, parallel with the primary form.

Lustre metallic. Color silver-white . . . steel-grey.

Hardness = 5·5. Sp. gr. = 6·097 . . . 6·129.

Compound Varieties. Massive: composition lamellar and granular.

1. Alone, in a mattrass, it decrepitates strongly, affording, at a red heat, sulphuret of arsenic, then sublimes as a transparent, yellowish-

brown mass, which, on cooling, remains clear. It is, according to BERZELIUS, an arsenical sulphuret of Nickel.

2. *Analysis.*

	By BERZELIUS.		By PFAFF.
Sulphur	19·24	14·40	12 36
Arsenic	45·34	53·32	45 90
Nickel	29·94	27·00	24·42
Cobalt	0·92	0·00	0·00
Iron	4·11	5·29	10·46
Silica	0·90	0·00	0 00

3. The variety examined by BERZELIUS was massive, and came fro the cobalt mines of Loos in Helsingland, Sweden: that above describe as crystallized, is found among the old ores from the mine Albertin near Harzgerode in the Hartz. It is accompanied by Spathic Iron, Ca careous Spar, Fluor, Quartz, Galena, and Copper Pyrites.

NICKEL-GREEN. Habroneme Malachite-Haloide.

In capillary crystals, and massive; composition impalpa ble, pulverulent. Fracture, fine splintery to uneven, com monly earthy.

Color, apple-green, siskin-green, to greyish white. Streal greenish white.

Soft.

1. Heated in a matrass, it yields moisture, and becomes of a dark shade of color. Upon charcoal, before the blowpipe, it smells of ars nic; and when submitted to the inner flame, it yields a metallic globul which contains this metal.

2. *Analysis.*

By BERTHIER.

from Allemont.

Arsenic acid	37·29
Oxide of nickel	36·49
Water	26·22
Oxide of cobalt	0·00

36·80
36·20
25·50
0·25

3. It occurs with Copper-Nickel at Allemont in Dauphiny, and probably in Saxony, Cornwall, and elsewhere, with the same mineral.

NICKELIFEROUS GREY ANTIMONY. (See *Nickel-Stibine.*)

NICKELINE. (See *Copper-Nickel.*)

NICKEL-OCHRE. (See *Nickel-Green.*)

NICKEL-STIBINE. Antimonial Eruthleucone-Pyrites.

Primary form. Cube.

Cleavage, parallel with the cube, perfect.

Massive: composition granular.

Lustre metallic. Color steel-grey, inclining to silver white.

Brittle. Hardness = 5·0 . . . 5·5. Sp. gr. = 6·451, a cleavable variety.

1. Before the blowpipe, it is partly volatilized, during which, the supporting charcoal is covered with a white coating; at last, it melts into a metallic globule, which communicates a blue color to glass of borax.

2. *Analysis.*

	By STROMEYER.	By KLAPROTH.
Nickel	36·60	25·25
Antimony	43 80	47·75
Arsenic	0 00	11·75
Sulphur	17·71	15·25
Iron and manganese	1·89	0·00

3. It is found in several mines in the principality of Nassau, along with Spathic Iron, Yellow Copper-Pyrites and Galena.

NIGRINE. (See *Rutile.*)

NITRATE OF LIME. (See *Nitrocalcite.*)

NITRATE OF MAGNESIA. (See *Nitro-Magnesite.*)

NITRATE OF POTASH. (See *Nitre.*)

NITRATE OF SODA. (See *Soda-Nitre.*)

NITRE. Prismatic Nitre-Salt. Mohs.

In capillary crystals and crusts.*

Lustre vitreous. Color white. Streak white.

Transparent . . . semi-transparent.

Sectile. Hardness = 2·0. Sp. gr. = 1·936.

Taste saline and cool.

1. It dissolves very easily in water, is not altered on being exposed to the air, and detonates with combustible substances.

2. *Analysis.*

By Klaproth.

Nitrate of potash	- - - -	42·55
Sulphate of lime	- - - -	25·45
Muriate of lime	- - - -	0·20
Carbonate of lime	- - - -	30·40

3. Nitre generally occurs in thin crusts on the surface of the earth, sometimes upon limestone, chalk, or calcareous tufa; also in limestone caves, and in sandstone.

4. Spain, Italy and Hungary, afford considerable quantities of this salt: in a higher state of purity, also, it is found in India. But especially in the United States, has it been found in large quantity, in limestone caves in the south western states. In Madison county, Kentucky, there is a cave 1936 feet long and 40 wide, which contains Nitre, intermingled with earthy matter and nitrocalcite. One bushel of the earth affords, by lixiviation with wood ashes, from three to ten pounds of Nitre. It is also met with, in the same vicinity, in loose masses, weighing several pounds, or imbedded in sandstone.

5. Its chief employment is in the production of gunpowder.

NITROCALCITE. Calcareous Earthy-Salt.

In efflorescent masses and silken tufts.

Color white or grey.

* The artificial crystals are right rhombic prisms of 120°, which commonly have the acute lateral edges and acute solid angles truncated. Twin crystals are also common, the face of composition being parallel with M.

1. It is very deliquescent, and soluble in water. On burning coals, it melts slowly, with slight detonation, and dries; the residue does not afterwards attract moisture from the air. It consists of lime 32·, nitric acid 57·44, water 10·56.

2. It is found in silky efflorescences, in caverns of limestone in Kentucky.

3. It is employed in the manufacture of saltpetre.

NITROGEN. Pure Nitrogen-Gas.

Gaseous. Transparent.

Sp. gr. = 0·9722.

1. Nitrogen-gas extinguishes flame and animal life, and is destitute of taste and smell. It is absorbable by about 100 volumes of water.

2. It is developed, in a state of purity, or nearly so, from the surface of the ground, over an extent of four or five acres, in Hoosick, Rensselaer county, (N. Y.) becoming manifest wherever there is water. Also, at New Lebanon Springs, in the immediate vicinity, but in smaller quantities. It is evolved, in like manner, by many well known mineral springs of other countries, as those of Cheltenham and Harrowgate.

3. The origin of Nitrogen-gas has been attributed to the decomposition of atmospheric air, contained in cavernous rocks; its nitrogen and oxygen uniting to form nitric acid, which would leave an excess of nitrogen, equal at least to ten times the quantity required for the complete saturation of the oxygen in the compound nitric acid.

NITRO-MAGNESITE. Magnesian Earthy-Salt.

In deliquescent efflorescences.

Color white.

1. It is very deliquescent; and consists, when pure, of

Nitric acid - - - - - -	72
Magnesia - - - - - -	28.

2. It is found in limestone caves, accompanying the Nitrocalcite.

3. It is said to be employed in the manufacture of saltpetre.

NONTRONITE.

Massive: in round shaped masses, composition impalpable.

Color straw-yellow. Opake.

Okenite.

Unctuous and tender. Scratched by the nail. Exhales no argillaceous odor when breathed upon.

1. It increases one tenth in weight from soaking in water. After calcination, it is magnetic.

2. *Analysis.*

By BERTHIER.

Silica	44·0
Peroxide of iron	29·0
Alumina	3·6
Magnesia	2·1
Water	18·7

3. It is found in the ore of manganese, worked at the village of Pardoux, in the department of Dordogne in France. It occurs in onion-shaped masses of the size of the fist.

NOSIAN. (See *Sodalite.*)

NUTTALLITE. (See *Scapolite.*)

OBSIDIAN. (See *Pitchstone.*)

OCTAHEDRITE. (See *Anatase.*)

OKENITE.

In delicately fibrous masses.

Lustre glimmering, approaching to pearly. Color white, with a shade of yellow or blue. Translucent on the edges.

Hardness, between Fluor and Feldspar. Sp. gr. = 2·28.

1. Before the blowpipe, it melts easily into a porcelainous mass. Pieces thrown into muriatic acid, become, after some time, translucent and gelatinous at the surface, which change, gradually extends through the masses. The powdered mineral is easily decomposed by this acid, the silica appearing throughout the solution in the form of flocculi.

2. *Analysis.*

By KOBELL.

Silica	56·99		55·64
Lime	26·35		26·59
Water	16·65		17·00
Alumina, oxide of iron, and traces of potash,			0·53

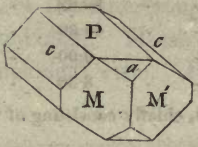
3. It is found, along with Zeolitic minerals, in amygdaloid in Greenland.

OLIVENITE. Prismatic Copper-Baryte.

Primary form. Right rhombic prism. M on M = 110° 50′.

Secondary form.

Fig. 328.



M on *a*	-	-	-	132° 7′
c on *c*, over P	-	-	-	92 30

Cleavage, traces parallel to M and *c*, the former being a little more distinct. Fracture conchoidal, uneven. Surface, M concave, *c* convex.

Lustre adamantine, indistinct. Color, various shades of olive-green, passing into leek-green, pistachio-green, and blackish green; into liver-brown and wood-brown, or also into siskin-green. Streak olive-green . . . brown. Semi-transparent . . . opake.

Brittle. Hardness = 3·0. Sp. gr. = 4·2809.

Compound Varieties. Globular and reniform shapes; surface rough, sometimes drusy; composition columnar, generally very perfect, straight and divergent, rarely promiscuous. If the composition be very thin, the lustre becomes pearly. Massive: composition columnar. Sometimes repeated composition; granular and columnar; curved lamellar and columnar. The faces of the first composition rough, of the second composition, smooth.

1. Heated alone before the blowpipe, it remains unchanged. Upon charcoal, it melts with a kind of deflagration, and is reduced. A white

metallic globule is formed, which, in the process of cooling, becomes covered with a red coating of sub-oxide of copper. In some varieties, a scoria is formed round the metallic globule. It is soluble in nitric acid.

2. *Analysis.*

	By Klaproth.	By Chenevix. var. Wood-Copper.	By Kobell.
Oxide of copper	50·62	50·00	56·43
Arsenic acid	45·00	29 00	36·71
Phosphoric acid	0·00	0·00	3·36
Water	3·50	21·00	3·50

3. It is found in veins, chiefly consisting of various ores of copper, and of Quartz.

4. It occurs in the copper-mines near Redruth in Cornwall, and in the Tynehead mine near Alston-moor in Cumberland.

Olivine. (See *Peridot.*)

Omphazite. (See *Pyroxene.*)

OPAL. Uncleavable Quartz. Mohs.

Regular forms, and cleavage, unknown.

Fracture conchoidal, of various degrees of perfection, sometimes highly perfect.

Lustre vitreous, in some varieties inclining to resinous. Color white, yellow, red, brown, green, grey; none of them lively, except some red and green ones, and generally pale; dark colors, owing to foreign admixtures. Streak white. Transparent . . . translucent, sometimes only on the edges, or even opake, if the colors be dark. Lively play of light observable in some varieties; others exhibit different colors by reflected and refracted light.*

* The play of light appears to depend upon openings in the interior of the mass of Opal, which are not fissures, but of an uniform shape, and reflecting the tints of Newton's scale. In some varieties of Hydrophane they are so large, that these colors cannot be any longer reflected by the included air; but they appear when filled with water, and of still higher tints, if filled with fluids possessing a high refractive power.

Opal.

Hardness $=5{\cdot}5 \ldots 6{\cdot}5$. Sp. gr. $=2{\cdot}091$, a milk-white variety; $=2{\cdot}060$, a brownish red variety.

Compound Varieties. Small reniform, botryoidal, and stalactitic shapes, and large tuberose concretions: surface of the former smooth, of the latter rough, composition impalpable, fracture conchoidal. Massive, composition impalpable; fracture conchoidal, even. Pseudomorphoses of Calcareous Spar.

1. The present species has been greatly subdivided into varieties, and even treated of under several different species. *Hyalite* (amiatite) included the small reniform, botryoidal, and sometimes stalactitic shapes, white, and generally transparent; *Menilite*, the large tuberose forms, of a brownish-grey color, and opake; *Precious Opal*, the varieties which exhibit the play of colors; *Wood-Opal*, those which appear in the shape of trunks, branches, and roots of trees; *Common Opal*, and *Semi-Opal*, consist of those varieties which have a conchoidal fracture, with medium degrees of transparency and lustre; *Hydrophane*, of an opake, dull variety, which becomes translucent on being immersed in water or some transparent fluid. *Siliceous Sinter* is a deposit from hot springs, &c., and according to its specific gravity belongs to the present species.

2. Before the blow-pipe, water is disengaged, the mineral decrepitates and becomes opake, showing the properties of pure silica. Two pieces rubbed together, give a phosphorescent light, like Quartz.

3. *Analysis.*

	By Bucholz.	By Klaproth.	
	var. Hyalite.	var. Precious Opal.	var. Menilite.
Silica	92·00	90·00	85 50
Water	6·33	10·00	11·00

The Menilite, like several other varieties, contains a small proportion of oxide of iron, alumina, lime and carbon. One variety, called *Opal-Jasper*, contains 47 p. c. of oxide of iron. The contents of water are considered foreign to the mixture of the mineral, and are supposed to change with the hygrometric state of the atmosphere.

4. Opal forms short, irregular veins, generally in porphyry. It often accompanies Calcedony in the vesicular cavities of amygdaloidal rocks, and even in agate balls. Menilite is found in adhesive clay-slate. Some

varieties are met with in metalliferous veins, along with Galena and Blende. It also occurs in petrifactions in sandstone.

5. Opal is found more plentifully in Hungary than in any other European country. The only deposit of Precious Opal in that country, is at Czerwenitza near Caschau, along with common and semi-opal, in a kind of porphyry. Traces of it have been met with at Hubertsburg. Fine varieties have lately been discovered in the Faroe islands; and most beautiful ones, sometimes quite transparent, near Gracias a Dios in the province of Honduras, America. Common Opal occurs in great quantities, at Telkobanya near Eperies, and in other parts of Hungary; in the Faroe islands, in Saxony, &c. An apple green variety is found at Kosemütz in Silesia, with Chrysoprase; and the red and yellow, bright colored varieties of Fire Opal, near Zimapan in Mexico. Semi-Opal occurs in several of the countries mentioned above; also near Frankfort, on the Maine, in Austria, Moravia, Poland, Siberia, &c. In Saxony, Bohemia and Cornwall, it is met with in metalliferous veins. Hyalite is found in amygdaloidal rocks, near Frankfort, in irregular veins; near Schemnitz in Hungary, in porphyry; also in Bohemia and various other countries. Menilite occurs at Menil Montant near Paris. Opal-Jasper is formed, wherever Opal happens to be mixed with oxide of iron, as at Telkobanya in Hungary, near Almas, and Tökörö in Transylvania. Wood-Opal is frequently found at Kremnitz and Telkobanya in Hungary, and in many districts of Transylvania, sometimes in very large trees. The only variety hitherto found in the United States, is the Hyalite, which occurs in Burke and Scriven cos., (Georgia,) lining cavities in a siliceous-shell rock. The siliceous-sinter variety occurs in small quantity at the Suanna spring in Florida.

6. Precious Opal, when possessing vivid colors, is highly prized as a gem; and is generally cut with a convex surface.

ORPIMENT. Yellow Melacone Blende. Mohs.

Primary form. Right rhombic prism. M on M = 100°.

Orpiment.

Secondary form.

Fig. 329.

M on c	120°	00?	Phillips.	M′ on i	162°	38′
M on f	140	00		c on c'	83	30
M on g	177	54		c on b	145	50

Cleavage, parallel with M not very perfect, or only in traces, but parallel with f highly perfect. The faces of cleavage are streaked parallel to the edges of intersection with M. Fracture scarcely observable. Surface, f rough, but even; all the other faces are streaked parallel to their edges of combination with M, and generally uneven.

Lustre pearly metallic upon the perfect faces of cleavage, the rest resinous. Color, several shades of lemon-yellow. Streak lemon-yellow, generally, a little paler than the color. Semi-transparent . . . translucent on the edges.

Sectile. Thin laminæ are highly flexible. Hardness $=1{\cdot}5 \ldots 2{\cdot}0$. Sp. gr. $=3{\cdot}480$, a cleavable variety.

Compound Varieties. Reniform, botryoidal, and other imitative shapes: composition curved lamellar, faces of composition commonly rough. Massive: composition granular, of various sizes of individuals; faces of composition uneven, often irregularly streaked.

1. Before the blow-pipe, upon charcoal, it burns with a blue flame, and emits fumes of sulpur and arsenic. It is soluble in the nitric, muriatic and sulphuric acids.

Orpiment.

2. *Analysis.*

	By KLAPROTH.	By LAUGIER.
Sulphur	38·00	38·14
Arsenic	62·00	61·86

3. Orpiment is found in imbedded nodules, and rarely in imbedded crystals, in blue clay, accompanied by sulphur.

4. It occurs at Tajowa near Neusohl in Lower Hungary, in the neighborhood of Vienna, and in Wallachia and Servia. At Kapnik in Transylvania, and Felsöbanya in Upper Hungary, it occurs in metalliferous veins, with Galena, Blende, Native Arsenic and Realgar. It is found likewise in Natolia, China and Mexico.

5. It is used as a pigment.

ORTHITE. (See *Allanite.*)

OSMELITE.

Massive: composition columnar, individuals thin and scopiformly or stellularly arranged, and these aggregations collected again into coarse granular concretions.

Cleavage only in one direction.

Lustre resinous or oily. Color greyish white, but after being exposed to the weather, dark hair-brown. Translucent.

Hardness intermediate between 4·0 and 5·0. Sp. gr. = 2·79... 2·83.

1. It emits at common temperatures an argillaceous odor, which is increased by breathing upon it. In the mouth it tastes like clay, but undergoes no separation of parts.

2. It occurs in Calcareous Spar mixed with Datholite in veins in Trachyte, at Niederkerchen, near Wolfstein on the Rhine.

OSTRANITE.

Primary form. Right rhombic prism. M on M = 96°.

Secondary forms. The primary form, having the acute lateral edges slightly modified, and the angles of the base deeply truncated.

Cleavage, parallel to the smaller diagonal of the base, scarcely perceptible.

Lustre vitreous. Color clove-brown.

Hardness = 7·0 ... 8·0. Sp. gr. = 4·3 ... 4·4.

1. Alone, before the blow-pipe, it does not melt, but becomes paler. With borax, it melts with difficulty into a transparent glass.

2. It is found in Norway.

Ouvarovite.

Primary form. Rhombic dodecahedron.

Lustre vitreous. Color emerald-green. Transparent.

Harder than Garnet.

1. It does not fuse when heated before the blow-pipe, nor lose its color or transparency.

2. It is found imbedded in Chrome-Ore, in the environs of Bissersk in Siberia.

Oxahevrite.

Primary form. Octahedron with a square base.

Secondary form. The primary, having the angles at the base truncated, so as to form when enlarged the faces of a square prism.

Cleavage perpendicular to the axis, but with much difficulty. Surface even, but not brilliant.

Color, light-grey, leek-green, olive-green, and reddish-brown.

Hardness, rather below Apatite. Sp. gr. = 2·21.

Compound Varieties. Massive: in thin seams and veins.

1. *Analysis.*
By Turner.

Silica	50 76
Lime	22·39
Potash	4·18
Peroxide of iron	3·39
Alumina	1·00
Fluoric acid	a trace.
Water	17·00

2. It occurs in ligneous petrifactions, where the wood has been replaced by Calcareous Spar, of a fine ochre yellow color, and more or less crystallized. From Oxhaver in the north east of Iceland.

Oxide of Arsenic. (See *White Arsenic.*)

Ozokerite.

Massive. Composition impalpable.

Color, between green and brown.

Oxygen.

Hardness, may be kneaded between the fingers like dough Sp. gr. = 0·955 . . . 0·970.

1. It melts in the flame of a candle, into a clear mass. It is neither soluble in alcohol nor water, even when boiling, and but slowly so, in ether and spirits of turpentine. It burns like wax with a soft clear flame, and on being extinguished, diffuses an agreeable odor.

2. It occurs at Slauik in Moldavia.

OXYGEN. Pure Oxygen-Gas.

Gaseous. Transparent.

Sp. gr. = 1·1111.

1. Oxygen-gas is a powerful supporter of combustion. A freshly extinguished taper introduced into a small vial of it, is immediately rekindled with a slight explosion; and iron-wire, on being previously heated, burns in it, with brilliant scintillations. It is wholly free from odor and taste.

2. The evolution of oxygen from vegetables, its only natural source, depends upon the influence of vitality. The carbonic acid they absorb is decomposed, the carbon appropriated by the plant, while this species is set at liberty. Its emission from vegetables may be detected by exposing a healthy mint of some kind, in a bell-glass of water over a pneumatic cistern to the sun of a summer's day: the oxygen-gas will collect in the upper part of the receiver, and may be transferred to a convenient vessel, and tested in the usual manner.

PARANTHINE. (See *Scapolite.*)

PARGASITE. (See *Hornblende.*)

PAULITE. (See *Hypersthene.*)

PEARL-GLIMMER. (See *Margarite.*)

PEARLSPAR. (See *Dolomite.*)

PEARLSTONE. (See *Pitchstone.*)

PECTOLITE.

In spheroidal masses: composition columnar, diverging. Lustre vitreous to pearly. Color white, yellowish or greyish. Hardness, between Fluor and Feldspar. Sp. gr. = 2·69.

1. Before the blow-pipe, it yields a white, transparent glass. After having been calcined, it forms a jelly in muriatic acid.

2. *Analysis.*

By KOBELL.

Silica	51·30
Lime	33·77
Soda	8·26
Potash	1·57
Water	8·89
Alumina and oxide of iron	0·90

3. It occurs on Natrolite, a variety of Mesotype, at Monte Baldo in South Tyrol.

PEGAMITE.

Primary form. Right rhombic prism. M on M = 127 . . . 128°.

Secondary form. Primary form, having the acute lateral edges, and the acute terminal angles, truncated.

Cleavage, parallel with P, but difficult; also parallel with the shorter diagonal of the prism. Fracture conchoidal.

Lustre vitreous. Color green, pistachio, leek, apple or grass: also, pale mountain green, greenish grey, and greenish white. Streak white. Transparent or translucent.

Brittle. Hardness (scale of BREITHAUPT) = 5·25 . . . 5·50. Sp. gr. = 2·492 . . . 2 496.

1. Before the blowpipe, in the tube, it gives much water. On charcoal, it loses its color, imparting, at the same time, a beautiful green color to the flame of the lamp. It is infusible. It contains 23½ . . . 24 per cent. of water.

2. It has been found on a hill between the lakes Strieges and Frankenberg, where it occurs in a transition flinty slate.

3. It is probably a variety of Wavellite.

PEGMATOLITE. (See *Feldspar.*)

PELIOM. (See *Iolite.*)

PELOKONITE.

Massive; composition impalpable. Fracture conchoidal.

Lustre vitreous, feeble. Color bluish black. Streak liver-brown. Opake.

Hardness = 3·0. Sp. gr. = 2·50 . . . 2·56.

1. It is very soluble in muriatic acid, the solution having a pistachio-green color.

Peridot.

2. It is found in the Terra Amarilla and the Remolinos in Chili, along with Green Malachite, and an unknown, blackish brown mineral with a yellow streak.

Peponite.

Massive: composition lamellar, rarely columnar, impalpable. Cleavage, apparently parallel to the sides of a rhombic prism. Lustre pearly. Color lake, and mountain-green. Streak greenish white. Translucent, only on the edges.

Hardness = 2·0. Sp. gr. = 2·969.

Emits an argillaceous odor when moistened.

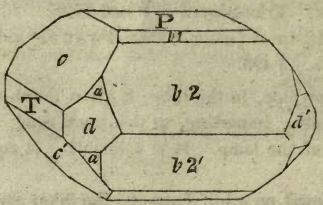
1. Locality not mentioned.

PERIDOT. Prismatic Chrysolite. Mohs.

Primary form. Right rectangular prism.

Secondary form.

Fig. 330.



P on T or *d*	-	-	90° 00′	Phillips.
P on *e*	-	-	140 00	"
P on *b*1	-	-	132 52	"
P on *b*2	-	-	115 00	"
T on *d*	-	-	130 00	"
e on *e*′	-	-	80 00	"
*b*2 on *b*2′	-	-	130 00	"
d on *d*′	-	-	100 00	"
d on *a*	-	-	160 00	"

Peridot.

Irregular forms, grains.

Cleavage, parallel with P easily obtained, sometimes traces of T. Fracture conchoidal. Surface, the faces of the prism streaked horizontally, those of the rest of the faces, smooth and even. The grains possess an uneven surface.

Lustre vitreous. Color various shades of green, as pistachio-green, olive-green, nearly asparagus-green and grass-green, sometimes passing into brown. Streak white. Transparent . . . translucent.

Hardness = 6·5 . . . 7·0. Sp. gr. = 3·441, a crystallized variety.

Compound Varieties. Irregular spheroidal masses, imbedded in rocks: composition granular, individuals easily separated, faces of composition uneven and rough.

1. Before the blow-pipe, it assumes a darker color, but does not melt or lose its transparency. It loses its color in nitric acid. Varieties of the present species may be produced artificially, by mingling the constituents in the requisite proportions, and exposing them to a high temperature.

2. *Analysis.*

	By Klaproth var. Chrysolite.	By Klaproth. var. Chrysolite. fr. meteoric iron.	By Shepard. var. Chrysolite. fr. meteoric stone.	By Klaproth. var. Olivine.
Silica	39·00	41·00	42·30	50·00
Magnesia	43·50	48·50	31·46	38·50
Ox. of iron	19·00	18·50	20·67	12·00
Lime	0·00	9·00	0·00	0·25
Soda, Ox. chrome, & Sulphur	0·00	0·00	5·57	0·00

3. The original repository of the implanted crystals of Peridot is not known: they are said to come from Upper Egypt, and are frequently brought to Europe by way of Constantinople. Less distinct crystals and imbedded grains are found in lava, in various kinds of basalt, &c., as in the neighborhood of Vesuvius, in Saxony, Bohemia, Silesia, Hungary,

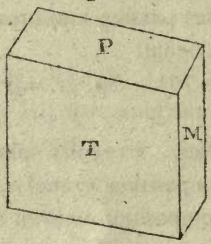
&c. It occurs in large spheroidal masses, which are not pebbles, mixed with Bronzite in Trap tuff, at Kapfenstein in Lower Hungary, and at Habichtswald in Hessia. It is contained also in the Meteoric Iron of Siberia, as well as in many meteoric stones that have fallen at different periods.

4. The transparent varieties are sometimes used as gems.

PERIKLIN. Heterotomous Feld-Spar. Mohs.

Primary form. Doubly oblique prism.

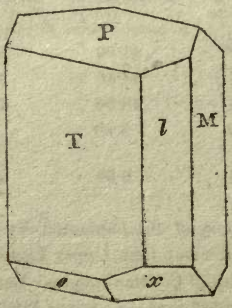
Fig. 331.



P on M	- - - -	93° 19′
M on T	- - - -	120 18
T on P	- - - -	114 45

Secondary form.

Fig. 332.



M on *l*	- - - -	120° 37′

Periklin.

Cleavage, parallel to P and T perfect, to M only in traces.

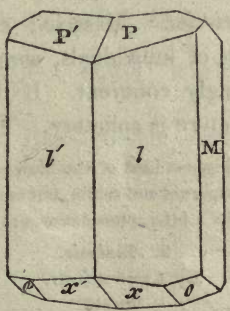
Fracture uneven.

Lustre pearly, sometimes vitreous upon P and T. Color white, yellowish and reddish. Streak white. Semi-transparent, to translucent on the edges.

Brittle. Hardness = 6·00. Sp. gr. = 2·54 . . . 2·55.

Compound Varieties. Twin-crystals; axis of revolution perpendicular to the prismatic axis.

Fig. 333.



Massive: composition granular.

1. Before the blow-pipe, it melts with difficulty into a semi-transparent glass.

2. *Analysis.*

By GMELIN.

Silica	67·94
Alumina	18·93
Soda	9·99
Potash	2·41
Lime	0·15
Protoxide of iron	0·48

3. It is found at Zöblitz in Saxony, entering into the composition of a sienite; also in crystals with Rutile in the Tyrol, on St. Gothard, and in the Saualpe of Carinthia.

PERITOMOUS LEAD-BARYTE. (See *Kerasite.*)

PETALITE. Prismatic Petaline-Spar. MOHS.

Primary form. Doubly oblique prism?

Cleavage, a prism of 95° nearly, and parallel with its longer diagonal; the latter more distinct. Fracture imperfectly conchoidal.

Lustre vitreous, inclining to resinous; pearly upon faces of cleavage. Color white, with tinges of blue, pink and green. Streak white. Translucent.

Brittle. Hardness = 6·0 ... 6·5. Sp. gr. = 2·439.

Compound Varieties. Massive; composition columnar, of various sizes of individuals, sometimes impalpable, and generally strongly coherent. If the composition be impalpable, the fracture is splintery. Extremely tough.

1. If exposed to the highest heat of the blow-pipe on charcoal, it becomes glassy, semi-transparent and white, but melts only upon the edges. If gently heated, it emits a blue, phosphorescent light.

2. *Analysis.*

	By ARFWEDSON.	By GMELIN.
Silica	79·212	74·17
Alumina	17·225	17 41
Lithia	5·761	5·16
Lime	0·000	0·32

3. Petalite occurs in the Swedish island of Utön, where it occurs in boulders of limestone, accompanied by Quartz, Feldspar and Tourmaline. In the United States, its only locality is Bolton, (Mass.) where it exists in a lime-quarry, along with Scapolite, Sphene and Pyroxene.

PETROLEUM. (See *Bitumen.*)

PETROSILEX.

Massive: composition impalpable. Fracture fine grained.

Lustre waxy. Colors various, grey, green, brown and red. Translucent.

Hardness = 7·0.

Pharmacolite.

1. Before the blow-pipe, it fuses with greater difficulty than Feldspar.

2. *Analysis.*

	By Berthier.	
	A red variety, from Sahlberg in Sweden.	A blackish green variety, from Aran.
Silica	79·5	67·60
Alumina	12·2	8·70
Lime	0·0	3·50
Soda	6·0	5·70
Potash	0·0	5·50
Magnesia	1·1	1·50
Oxide of iron	0·5	3 60

3. Petrosilex is probably a variety of Feldspar, or Albite.

PHARMACOLITE. Hemi-prismatic Gypsum-Mica.

Primary form. Right oblique angled prism.

Secondary forms.

Fig. 334.

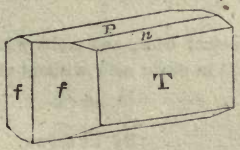
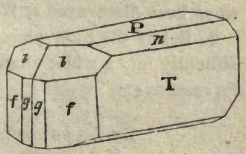


Fig. 335.



f on *f*	- -	117° 24′	Haidinger.
n on *n*	- -	141 8	"

The crystals are lengthened in the direction of T, (edges of combination between T, *n* and P,) and attached at one of the extremities, in most cases several together, so as to form stellated or divergent groups. On the disengaged terminations of the crystals, one of the faces *f* is enlarged, so as generally to make the other disappear.

Pharmacolite.

Cleavage, parallel to P highly perfect, and easily obtained. Fracture uneven. Surface, faces P and *n* are deeply streaked parallel to their common edges of combination.

Lustre vitreous. P slightly inclining to pearly, both upon faces of cleavage and of crystallization. Color white, inclining to yellowish. Streak white. Transparent, or translucent.

Sectile. Thin laminæ are flexible in a direction perpendicular to the edges between T, *n* and P.

Hardness $=2{\cdot}0 \ldots 2{\cdot}5$, nearer the latter. The perfect faces of cleavage are below 2·0. Sp. gr. $=2{\cdot}730$.

Compound Varieties. Globular aggregations of acicular crystals. Reniform, botryoidal and stalactitic shapes. Composition thin columnar ... impalpable. Farinaceous.

1. The crystals above described, were first observed upon a specimen whose locality is unknown, associated with the Haidingerite, but have since been discovered at Wittichen.

2. Before the blow-pipe, it emits an arsenical odor, and melts with difficulty into a white enamel. It is dissolved in nitric acid without effervescence.

3. *Analysis.*

	By Klaproth. fr. Wittichen.	By John. fr. Andreasberg.	By Turner.
Lime	25·00	27·28	76·92
Arsenic	50·54	45·68	
Water	24·46	23·86	27·08

4. It is found in the principality of Fürstenberg, at Andreasberg in the Hartz, at Riechelsdorf in Hessia, and other places, in veins that also contain Native Arsenic and Smaltine.

5. The description of the *Picropharmacolite* does not differ from that given above of the Pharmacolite. The only difference consists in a small quantity of magnesia, 3·218 p. c., which the former contains. It comes from the cobalt mines of Riechelsdorf in Hessia.

Pharmacosiderite. (See *Cube-Ore.*)

Phenakite.

PHASTINE.

Massive: composition lamellar, impalpable. Cleavage, parallel with the sides of a rhombic prism, in traces; also, with its two diagonals most distinct, parallel with the shorter.

Lustre pearly. Color grey. Streak white.

Hardness = 1·25 . . . 1·50. Sp. gr. = 2·825.

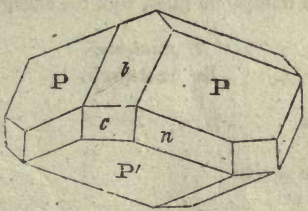
1. Locality not mentioned.

PHENAKITE. Phenakine Emerald.

Primary form. Rhomboid. P on P = 115° 25′.

Secondary form.

Fig. 336.



P on *b*	-	-	-	147°	42′	30″
P on *n*	-	-	-	122	17	30

Cleavage, parallel to *n*.

Lustre vitreous. Color bright wine yellow, inclining to red; also inclining to white. Transparent . . . opake.

Hardness, above Quartz. Sp. gr. = 2·969.

1. *Analysis.*

By HARTWALL.

Silica	55·14
Glucina	44·47
Alumina and magnesia	0·39

2. It is found in Perm, 85 wersts from Catharinenburg.

PICROLITE. Fibrous Atelene Picrosmine

Massive: composition thin columnar, consisting of straigh and delicate individuals. Fracture uneven, rarely splintery.

Lustre vitreous: in very thin individuals, satiny. Color some shade of green or greenish-white, greenish-grey mountain green, oil-green, leek-green, and blackish-green. Translucent on the edges.

Brittle, except in the finest fibres, when it is flexible. Hardness $=3{\cdot}0 \ldots 4{\cdot}0$. Sp. gr. $=2{\cdot}591$.

1. When heated before the blow-pipe in thin fragments, it coils up a the extremity, and fuses into an opake, white mass. With phosphoric salt, it melts into a transparent glass, with the exception of a skeleton o silica.

2. *Analysis.*

By Almroth.

Silica	40·04
Magnesia	38·80
Water	9·08
Protoxide of iron	8·28
Carbonic acid	4·70

3. This species, as first described by Hausmann, (with no other properties than its columnar composition, a faint pearly lustre, a leek green, to yellow color, streak a little shining, and hardness from 3·0.. 6·0,) was quoted as forming irregular veins in the beds of Magnetic Iron of Taberg and Nordmayken in Sweden, and as occurring a Reichenstein in Silesia. As described above, it has several localities in the United States. In particular, it occurs in large masses, which exis in irregular seams in the verd antique marble of West Haven and Milford, (Conn.); at which places the individuals are coarse, and sometimes a little curved. At Weathersfield in Vermont, it forms numerous narrow veins through a serpentine rock, which also contains Dolomite, the individuals being very thin, and exhibiting a satiny lustre. At Kelly Vale, in Vermont, also, it is found in somewhat wider veins, coarsely columnar, of a light oil-green color, and containing much yellow.*

* The foregoing American varieties afforded the description above given, respecting color, composition, specific gravity, hardness, and behavior before the blow-pipe. These also lost 13·04 p. c. wt., on calcination

Picrosmine.

The thin seams of Asbestus, so called, in the Serpentine of Newburyport, (Mass.) Newport, (R. I.) and numerous other places in New England, probably belong to this species.

PICNITE. (See *Topaz.*)

PICROPHARMACOLITE. (See *Pharmacolite.*)

PICROSMINE. Prismatoidal Atelene Picrosmine.

Primary form. Right rectangular prism: from cleavage.

Cleavage, affords the form in the annexed figure.

Fig. 337.

i on *i*	-	-	-	-	117° 49′
s on *s*	-	-	-	-	126 52

Parallel to M, the cleavage is perfect; parallel to T less so, and least of all, to *i*.

Fracture uneven, scarcely perceptible.

Lustre pearly, distinct upon M, inclining to vitreous upon the others. Color greenish-white, passing into greenish-grey and mountain-green, sometimes also oil-green, leek-green, and blackish green. Streak white, dull. Translucent on the edges.

Picrosmine.

Very sectile. Hardness = 2·5 . . . 3·0. Sp. gr. = 2·66, of a cleavable compound variety. 2·596, of a columnar variety.

Compound Varieties. Massive: composition granular, strongly coherent. If the composition becomes impalpable, the fracture is earthy. The particles of columnar composition are very thin; fracture splintery.

1. Before the blow-pipe, it is infusible, but gives out water, becoming first black, then white and opake, and acquires a degree of hardness nearly = 5·0. It is soluble in phosphoric salt, with the exception of a silica-skeleton. When treated with a solution of cobalt, it assumes a pale red color. It appears therefore, to contain water, silica and magnesia.

2. The cleavable varieties have been found, accompanied by Magnetic Iron, and Dolomite, in a bed in primitive rocks. The only locality hitherto known, is the iron mine called Engelsburg, near Presnitz in Bohemia.

3. It is likely that several varieties of Asbestus fall within the present species.

PICTITE. (See *Turnerite.*)

PIMELITE.

Nickel-Ochre, mixed with clay.

PINGUITE.

Massive: impalpable: resembles Green Iron-Ore.

Fracture large conchoidal.

Lustre resinous. Color, siskin-green and oil-green. Streak paler. Translucent on the edges.

Hardness = 1. Sp. gr. = 2·31.

Emits an earthy odor, when moistened.

1. *Analysis.*
By KARSTEN.

Silica	36·90
Peroxide of iron	29·50
Protoxide of iron	6·10
Alumina	1·80
Magnesia	0·45
Oxide of manganese	0·14
Water	25·10

2. It occurs in a vein of Heavy Spar, in the mine of Neu Beschert Glück, in the mine of Saxon Erzgebirge, and at Geilsdorf in Plauen.

PINITE. (See *Mica.*)

PISSOPHANE.

Stalactitic, massive, and impalpable. Fracture conchoidal. Lustre vitreous. Color pistachio-green, asparagus-green, and olive-green, passing into brown. Streak white; in the brown variety, a pale yellow. Transparent to translucent.

Hardness = 1·75 ... 2·50. Sp. gr. = 1·92 ... 1·98.

It falls to pieces in water.

1. It occurs at Reichenbach, and in Garnsdorf.

PITCHBLENDE. Uncleavable Baryte-Ore.

Regular forms and cleavage, unknown. Fracture conchoidal, uneven.

Lustre imperfectly metallic. Color greyish-black, inclining sometimes to iron-black, also to greenish black and brownish black. Streak black, a little shining. Opake. Brittle. Hardness = 5·5. Sp. gr. = 6·468.

Compound Varieties. Reniform: composition columnar, impalpable; aggregated into a second curved, lamellar composition, the faces of composition being smooth and shining. Massive: composition granular, individuals not distinguishable.

1. Alone, before the blow-pipe, it is infusible, but it melts with borax into a greyish scoria. If reduced to powder, it is slowly soluble in nitric acid.

2. *Analysis.*

	By KLAPROTH.	By PFAFF.
Protoxide of uranium	86·50	84·52
Protoxide of iron	2·50	8·24
Silica	5·00	2·02
Sulphuret of lead	6·00	4·20
Oxide of cobalt	0·00	1·42

3. It chiefly occurs in silver veins, and is accompanied by various ores of silver and lead, and often intimately mixed with Yellow Copper Pyrites and Galena.

4. Its chief localities are Johanngeorgenstadt, Marienberg, Annaberg, and Schneeberg in Saxony; and Joachimsthal and Fribus in Bohemia. In Cornwall, it has been found in the tin mines of Tincroft and Tolcarn, near Redruth.

5. It is used in painting upon porcelain, yielding a fine orange color in the enamelling fire, and a black one, in that in which the porcelain itself is baked.

PITCHSTONE. Empyrodox Quartz. Mohs.

Regular forms unknown. Grains.

Cleavage none. Fracture conchoidal, sometimes highly perfect, sometimes less distinct. Surface, the larger grains uneven and rough, the smaller ones smooth.

Lustre vitreous and resinous. Color black, brown, red, yellow, green, grey, white; none of them bright. There occurs a distinct velvet-black. Streak white. Faintly transparent . . . translucent on the edges.

Hardness = 6·0 . . . 7·0. Sp. gr. = 2·395, Obsidian from Iceland; =2·212, Pitchstone from Meissen.

Compound Varieties. Massive: composition granular, strongly connected, so as to be scarcely recognizable; fracture more or less perfectly conchoidal, uneven and splintery. The whole mass is often traversed with separating faces, which may be considered as rudiments of the faces of lamellar composition: often the composition is granular, thick or thin, and generally bent; the faces of composition being smooth, and possessing pearly lustre. Small grains of Obsidian are often enveloped in a number of successive thin coats; several of these are again surrounded by other coats, and so on several times, which pro-

duce a very remarkable composition. Vesicular: the cavities often elongated in one direction, parallel, and in such number, that the mass appears fibrous, and of a pearly lustre.

1. The varieties of Pitchstone have generally been treated of under four species: viz. Obsidian, Pitchstone, Pearlstone, and Pumice. *Obsidian* possesses the most perfect conchoidal fracture, and high degrees of a pure vitreous lustre. A variety of Obsidian which is transparent, is called *Marekanite*. When the high perfection of the conchoidal fracture disappears, and we meet with an uneven or splintery fracture, its lustre at the same time diminishing and passing into resinous, we are presented with the variety *Pitchstone*. Pitchstone often contains those faces of distinct concretion, which arise from composition. When these are numerous, variously curved, and containing but little matter between them, a transition into *Pearlstone* is formed; the peculiarity of which depends upon the roundish masses into which it separates, and which generally allow themselves to be resolved into thin films, not unfrequently including a grain of Obsidian. The Obsidian itself is often vesicular, the cavities being small, and keeping a constant direction. If there are a great many of them of larger sizes, the whole mass becomes apparently very light, the original color disappears, and there is pearly or silky lustre in one direction. Thus *Pumice* is generally formed.

2. Before the blow-pipe, these varieties melt with more or less facility, according to the fusibility of their ingredients, into a vesicular glass, or they yield an enamel.

3. *Analysis.*

	By Descotils.	By Berthier.	By Klaproth.		
	var. Obsidian.		var. Pitchstone.	var. Pearlstone.	var. Pumice.
Silica	72·00	69·46	73·00	72·25	77·50
Alumina	12 50	2·60	14·50	12·00	17·50
Potash Soda	10·00	7·12 5·08	0·00 1·75	4·50 0·00	3·00
Ox. iron and mang.	2 00	2·60	1·10	1·60	1·75
Lime	0·00	7·54	1·00	0·50	0·00
Magnesia	0·00	2·60	0·00	0·00	0·00
Water	0·00	3·00	8·50	4·50	0·00

Pitchstone.

4. Pitchstone forms mountain masses, and is generally in close connexion with porphyry. Many of the other varieties occur under similar circumstances. It is often the paste of certain kinds of porphyry, containing imbedded crystals of other minerals; and in a similar manner, Obsidian, Pearlstone, and Pumice, form, each their porphyry, denominated after the kind of paste which contains the crystals. All these varieties occur also in beds in sandstone, in which it has been observed that in some places they lie regularly between the strata, or abruptly assume another situation, interrupt the strata, and then appear in the shape of regular veins. Several of the pitchstone veins in red sandstone seem to have the same origin; but it cannot be determined whether this also is the case in similar veins in granite, where they likewise occur. Obsidian frequently occurs in grains. Pumice, and several of the other varieties of Pitchstone, are products of active volcanoes.

5. Considerable masses of very distinct Pitchstone occur on the foot of the Saxon metalliferous mountains at Meissen, also at Planitz near Zwickaw, passing into Obsidian in the isle of Arran. Pearlstone, including grains of Obsidian, is found between Tokay and Keresztur, and at Glashütte near Schemnitz in Hungary, at Cabo de Gata in Spain, near Ochotzk in Siberia, &c. Obsidian is very frequent in Iceland, where it exists in grains, angular pieces and beds; it is also found at Schemnitz and Glashütte in Hungary, of a green color at Moldauthein in Bohemia, and shewing every stage of the passage into Pumice, in the Lipari islands, also in Teneriffe, Peru, and New Spain. Pumice occurs at Vesuvius, in Ischia, the Lipari islands, and several islands of the Grecian Archipelago, in Teneriffe; near Tokay, Schemnitz, and other places in Hungary; near Andernach, and the lake of Laach on the Rhine; in Quito and Mexico, &c. In several of these countries, also, it is met with in conglomerates.

6. Obsidian is employed for mirrors, vases, snuff boxes, &c.; in Mexico and the island of Ascension, very sharp edged fragments are used as tools and weapons. Pumice yields a well known material for grinding and polishing, and is also employed as a filtering stone.

PITCHY IRON-ORE. (See *Iron Sinter* and *Triplite.*)

PLASMA. (See *Quartz.*)

PLEONASTE. (See *Spinel.*)

Plumbago.

PLUMBAGO. Rhombohedral Graphite-Mica. Mohs.

Primary form. Rhomboid, of unknown dimensions.

Secondary forms. 1. Six sided prism. 2. Six sided prism, with terminal edges truncated. The crystals invariably possess a tabular appearance.

Cleavage, perpendicular to the axis of the rhomboid, (or parallel with the bases of the hexagonal tables,) perfect. Fracture uneven, scarcely observable. Surface, bases of the prisms generally smooth, or faintly striated parallel to their edges of combination; the rest of the faces rough.

Lustre metallic. The highest degrees of lustre are found upon the perfect faces of cleavage, and upon the bases of the hexagonal tables. Color iron-black, dark steel-grey. Streak black, shining. Opake.

Sectile. Thin laminæ are highly flexible. Hardness $=1{\cdot}0 \ldots 2{\cdot}0$. Sp. gr. $=2{\cdot}0891$.

Compound Varieties. Massive: composition granular, the individuals flat and scaly, of various sizes, frequently impalpable. Of the latter, the fracture is conchoidal or even.

1. In a high degree of heat, it is combustible, and leaves a residue of oxide of iron. It is infusible.

2. *Analysis.*

	By Scheele.	By Vauquelin	By Saussure.
Carbon	81·00	92 00	96·00
Iron	10·00	8·00	4·00
Oxygen	9·00	0 00	0 00

3. The varieties of this species are found in beds, or form beds by themselves, in slaty and ancient trap-rocks. They seem often to replace Mica and Talc in certain rocks. It is particularly in beds of limestone that the crystallized variety of Plumbago occurs. It is likewise met with in the coal formation.

4. One of the most remarkable deposits of Plumbago is at Borrowdale in Cumberland, in a bed of trap, very much interrupted, and alternating with clay-slate. It occurs crystallized in Greenland, in the parish of Pargas in Finland; and different varieties are known from the Tyrol, Salzburg, Piedmont, France, Spain, and Norway.

Plumbago is of very common occurrence in the United States. Some of the handsomest crystallized varieties occur near Ticonderoga on Lake George, upon Roger's rock, where it is associated with Pyroxene and Sphene; and in the vicinity of Amity, Orange county, (N.Y.) at which place it occurs in white limestone, with Spinel, Brucite, Hornblende, &c. A compact variety is found in large masses, disseminated in veins through gneiss, at Sturbridge, (Mass.) A similar variety occurs at Grenville, (Lower Canada,) along with Sphene and Tabular Spar, in white limestone.

5. Plumbago is much employed in the manufacture of lead pencils, and of crucibles. It is also used to diminish friction, and to protect iron from oxidation.

PLUMBOCALCITE. Microtine Lime-Haloide.

Primary form. Rhomboid. P on P = 104° 53′ 30″.

Surface of the crystals rounded.

Lustre pearly. Color white. Transparent to translucent.

Hardness = 2·5...3·0. Sp. gr. = 2·82.

Compound Varieties. Massive.

1. Heated in a platina crucible, or in a glass tube, it decrepitates, and after some time assumes a brownish, or pale reddish, tint. A small fragment, dissolved in muriatic or nitric acid, gives a white precepitate, with caustic ammonia, which becomes black on the addition of hydrosulphuret of ammonia.

2. *Analysis.*
By TURNER.

Carbonate of lime	92·2
Carbonate of lead	7·8

3. It occurs at Wanlockhead in Scotland.

PLUMBO-GUMMITE. Staphyline Lead-Baryte.

Reniform. Surface smooth. Composition thin columnar . . . impalpable.

Cleavage, parallel with the sides of a rhombic prism, in traces. Fracture conchoidal.

Lustre resinous. Color yellowish-brown and reddish-brown, striped. Translucent.

Hardness = 4·0 . . . 4·5. Sp. gr. = 6·3 . . . 6·4.

If rubbed in an isolated state, it acquires a strong negative electricity.

1. If quickly heated before the blow-pipe, it decrepitates, and loses its water; but is infusible by itself. With borax, it yields a transparent, colorless glass, without reducing the lead. Its powder is decomposed by concentrated muriatic acid.

2. *Analysis.*

By Berzelius.

Oxide of lead	40·14
Alumina	37·00
Water	18·80
Sulphurous acid	0·20
Lime, oxides of iron and manganese	1·80
Silica	0·60

3. It occurs at Huelgoet, near Poullaouen in Brittany, in clay-slate, along with Galena, Blende, Iron Pyrites and Pyromorphite.

Plusin-Glance.

Massive; in druses.

Color, between iron-black and blackish lead-grey.

Hardness (scale of Breithaupt) = 3. Sp. gr. = 6·189 . . . 6·244.

1. It is found at Freiberg.

POLYBASITE. Axotomous Polypoione-Glance.

Primary form. Regular hexagonal prism?

Secondary form. The primary, having the terminal edges replaced by three or six planes.

Surface of the crystals streaked upon the terminal planes, parallel to the sides of an equilateral triangle, or parallel to the alternating edges of the six-sided prism. Fracture uneven.

Lustre splendent. Color, iron-black.

Sectile. Hardness between Common Salt and Calcareous Spar. Sp. gr. = 6·214.

Compound Varieties. Massive.

1. *Analysis.*

	By Rose.		By Brandes.
	fr. Mexico.	fr. Schemnitz.	fr. Neu-Morgenstern.
Sulphur	17·04	16·83	19·4000
Antimony	5·09	0·25	0·0000
Arsenic	3·74	6·23	3·3019
Silver	64·29	72·43	65·5000
Copper	9·93	3·04	3·7500
Iron	0·06	0·33	5·4600
Zinc	0·00	0·59	0·0000

2. It occurs partly in super-imposed crystals, partly massive and disseminated, in the mine of Guanaxuato, in Mexico; also at Guansamez in Durango, with yellow Copper Pyrites and Calcareous Spar; also with Stilbite, at Andreasberg in the Hartz, and probably near Freiberg.

POLYHALLITE. Stelene Brithyne-Salt.

Massive: composition columnar. Cleavage parallel with a prism of 115°. Fracture splintery, uneven.

Lustre resinous. Color smoke-grey and pearl grey, flesh-red and brick-red.

Hardness greater than 3·0. Sp. gr. = 2·7689. Stromeyer.

Taste saline and bitter.

1. In the flame of a candle, it melts into an opake globule, and is readily dissolved in water, the solution letting fall a precipitate of sulphate of lime.

2. *Analysis.*

By BERTHIER.

	from Vic.		
	Crystallized.	Red mass. var.	Grey mass. var.
Sulphate of lime	40·0	45·0	40·0
Sulphate of soda	37·6	44·6	29·4
Sulphate of mang.	0·5	0·0	0·0
Sulphate of magnesia	0·0	0·0	17·6
Chloride of sodium	15·4	6·4	0·7
Alumina and ox. iron	4·5	3·0	4·3
Loss by calcination	2·0	1·0	8·0

By STROMEYER.

from Ischel.	
Anhydrous sulphate of lime	22·2184
Anhydrous sulphate of potash	27·6347
Anhydrous sulphate of magnesia	20·0347
Anhydrous sulphate of iron	0·2927
Hydrous sulphate of lime	28·4580
Chloride of sodium	0·1910
Chloride of magnesium	0 0100
Peroxide of iron	0·1920

3. It occurs at Berchlesgaden and Ischel, along with Common Salt, Gypsum and Anhydrite; also in the salt mines of Vic in Lorraine.

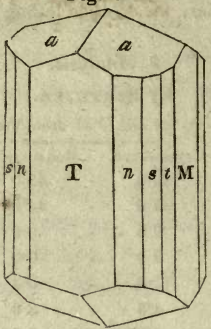
POLYMIGNITE. Melanous Eruthrone-Ore.

Primary form. Right rhombic prism.

Secondary form. Primary, having the lateral edges deeply truncated, or slightly bevelled, and terminated by four-sided pyramids, which, viewed as an octahedron with a rhombic base, have angles of 136° 30′ and 116° 30′.

Polymignite.

Fig. 338.



Cleavage, imperfect in the direction of the replacing faces of the prism. Fracture conchoidal.

Lustre metallic. Color black. Streak brown. Opake. Hardness = 6·5. Sp. gr. = 4·8.

1. Alone, upon charcoal, before the blow-pipe, it is unaltered. With borax, it melts into an iron-colored glass. With salt of phosphorus, it is with difficulty dissolved; the glass appearing reddish in the reduction fire, and the color not undergoing change from the addition of tin. With soda, it becomes greyish-red, but does not melt.

2. *Analysis.*

By Berzelius.

Titanic acid	46·30
Zirconia	14.14
Oxide of iron	12·20
Lime	4·20
Oxide of manganese	2·70
Oxide of cerium	5·00
Yttria	11·50

3. Its locality is Fredrichsvärn, Norway, where it is found in Zircon-sienite.

4. Very small, iron-black crystals, of a prismatic form, which gave with the common goniometer $\breve{M}$ on M = about 100°, are found with the Green Feldspar in sienite, at Beverly, (Mass.) These prisms have their lateral edges truncated. Hardness = 6 5. Streak brown; lustre me-

tallic. Infusible before the blow-pipe, alone; with salt of phosphorus, very slowly soluble, and the globule assuming a yellowish color.

Polysphærite.

In single rounded balls or drops, whose internal structure is concentric.

Lustre resinous. Color, liver-brown, clove-brown, yellowish-brown, yellowish grey, and nearly isabella-yellow. Streak white.

Hardness (scale of Breithaupt) = 4·0. Sp. gr. = 5·89... 6·092.

1. It is composed of oxide of lead, phosphoric acid, and alumina.

2. It is taken occasionally from diggings in the district of Freiberg: it is also found at Georgenstädter.

Poonahlite.

Primary form. Right rhombic prism. M on M′ = 92° 20′.

Lustre vitreous. Color white. Transparent... translucent.

Hardness nearly that of Mesotype.

1. It is found implanted upon, and traversing Apophyllite, and associated with Stilbite, Epistilbite and Calcareous Spar, at Poonah in the East Indies.

Prase. (See *Quartz*.)

PREHNITE. Axotomous Kouphone-Spar. Mohs.

Primary form. Right rhombic prism. M on M′ = 99° 30′.

Secondary forms.

Fig. 339.

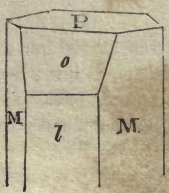
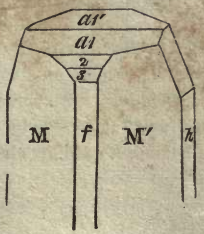


Fig. 340.



Prehnite.

o on *o* over the summit	31°	00′	
M or M′ on *f*	139	45	PHILLIPS.
*a*1′ on *a*1′	177	20	"
*a*1′ on *f*	92	00	"
*a*1′ on M	91	30	"
c on M	128	30	"

Cleavage, very distinct in the direction of P, less distinct in that of M. Surface, P and *a*1 often streaked, the lateral faces streaked perpendicularly.

Lustre vitreous, except upon P, which possesses pearly lustre, particularly if produced by cleavage. Color, various shades of green, as leek-green, mountain-green, apple-green, siskin-green, &c.; passing into white and grey. Streak white. Semi-transparent . . . translucent.

Brittle. Hardness = 6·0 . . . 7·0. Sp. gr. = 2·926.

Compound Varieties. Reniform, globular, stalactitic shapes: surface generally drusy; composition columnar, sometimes broad, imperfect and strongly coherent; if the particles of composition be distinct, the surface is often pretty smooth. Massive: composition either columnar, as above, or granular, and even sometimes impalpable. Sometimes compound varieties are again aggregated in a second composition, the faces of composition being rough and uneven.

1. Before the blow-pipe, upon charcoal, it is transformed into a white frothy scoria, which, on a continuance of the heat, melts into a compact, colored globule. With borax, it melts into a transparent bead. In dilute muriatic acid, it is slowly dissolved, leaving behind a flaky residue. When heated, it exhibits electric poles.

Prehnite.

2. *Analysis.*

	By KLAPROTH. fr. Cape of Good Hope.	By WALMSTEDT. fr. Dunbarton.	By LAUGIER. fr. the Palatinate.
Silica	43·83	44·10	42·50
Alumina	30·33	24·26	28·50
Lime	18·33	26·43	20·40
Oxide of iron	5·66	0·74	3·00
Water	1·83	4·18	2·00
Potash and soda	0·00	0·00	0·75

3. It occurs in veins in granite, gneiss, and sienite; but is more common in balls, irregular veins and vesicular cavities in trap.

4. It was first brought to Europe by Col. PREHN, from the Cape of Good Hope, in bright colored apple-green varieties. The crystallized varieties come from the Alps of Savoy and Dauphiny. Massive and imperfectly crystallized specimens occur at St. Gothard in Switzerland, in the Tyrol, in Salzburg, Carinthia, in the Pyrenees, in Norway and Sweden. It occurs in considerable quantity near Glasgow in Scotland, also at Reichenbach near Oberstein in the Palatinate, and in the Faroe Islands. In the United States, handsomely crystallized and massive varieties, of a rich green color, are found at Farmington, (Conn.) in trap. Others, less beautiful, are found occasionally throughout the trap region of New England and New Jersey. It occurs in veins in gneiss, at Bellows Falls, (Vt.) and at Charlestown, (Mass.) in sienite.

PRISMATOIDAL COPPER-GLANCE.

Primary form. Right rhombic prism.

Secondary form. The primary, having the acute lateral edges truncated, and the acute solid angles so deeply truncated, as to produce dihedral summits.

Cleavage parallel with the secondary lateral planes, rather perfect, though interrupted. Fracture imperfectly conchoidal. Surface rough.

Lustre metallic. Color blackish lead-grey. Streak unchanged.

Brittle. Hardness = 3·0. Sp. gr. = 5·735.

Compound Varieties. Massive: composition granular, individuals strongly connected.

1. Before the blow-pipe, it gives nearly the same results as Bournonite, with which it appears to agree in chemical composition.

2. It has been found in the beds of Spathic Iron at St. Gertraud, near Wolfsberg in the valley of the Lavant, in Carinthia.

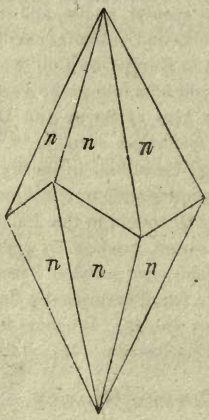
3. With the exception of form, which, however, has not been satisfactorily determined, it resembles very closely the species Bournonite.

PROUSTITE. Aphotistic Melacone-Blende.

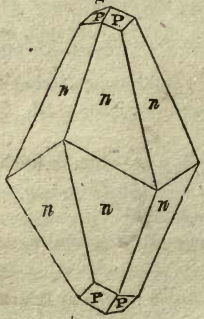
Primary form. Rhomboid. P on P = 107° 36′.

Secondary forms.

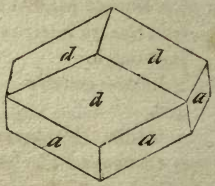
1. Fig. 341.



2. Fig. 342.

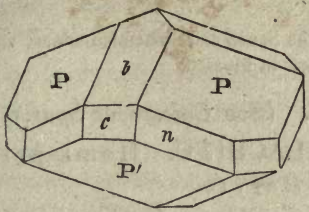


3. Fig. 343.



Proustite.

4. Fig. 344.



5. Fig. 343, with the edges between *d* and *d* truncated.

Cleavage, parallel with P rarely distinct. Fracture conchoidal . . . uneven. Surface, *d* streaked parallel to its upper edges; *a*, vertically.

Lustre adamantine. Color cochineal-red. Streak the same as color. Semi-transparent to translucent on the edges.

Hardness = 2·0 . . . 2·5. Sp. gr. = 5·524, a cleavable variety from Annaberg; 5·422, a dark red variety, from the Churprinz mine near Freiberg.

Compound Varieties. Twin-crystals, and massive, composition granular, of various sizes of individuals.

1. When heated before the blow-pipe; it decrepitates at first; it then melts with a bluish flame, emitting sulphurous acid, and in a more powerful heat, the odor of arsenic; and finally yields a metallic globule, which is reducible to pure silver. Its solution in nitric acid, gives a citron-yellow precipitate of sulphate of arsenic.

2. *Analysis.*

	By Rose. from Joachimsthal.		By Proust.
Sulphur	19·51	Sulphuret of arsenic	25·00
Antimony	0·69	Sulphuret of silver	74·35
Arsenic	15·09	Oxide of iron	0·65
Silver	64·67		

3. It occurs associated with various ores of silver, several species of Pyrites, and particularly with Native Arsenic and White Iron-Pyrites.

4. It is found in the Saxon and Bohemian mines, and is particularly abundant at Zacatecas in Mexico.

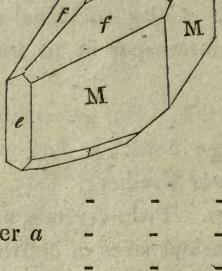
PRUNNERITE. (See *Calcareous Spar.*)

PSEUDO-MALACHITE. Hemi-prismatic Copper-Baryte.

Primary form. Oblique rhombic prism. M on M = 142° 30′.

Secondary form.

Fig. 345.



b on *e*	-	-	-	141°	4′
o on *o* over *a*	-	-	-	112	37
a on *e*	-	-	-	90	00
f on *f*	-	-	-	117	49

Cleavage. Slight indications parallel to *b′* and *e*. Fracture small conchoidal, uneven. Surface, *a* and *f* a little rough, though even; M smooth but uneven. The rest of the faces smooth and even.

Lustre adamantine, inclining to vitreous. Color emerald-green, verdigris-green, blackish green, often darker at the surface. Streak green, a little paler than the color. Translucent, often only on the edges.

Brittle. Hardness = 4·5 . . . 5·0. Sp. gr. = 4·205, a crystallized variety, from Rheinbreitbach near Bonn.

Compound Varieties. Reniform, rather imperfect: composition imperfectly columnar; surface drusy, and often of a darker color. Massive: composition as above.

1. Before the blow-pipe, it melts with ease, and is converted into a small, vesicular, metalloidal globule. It is soluble without effervescence, in nitric acid, particularly if heated.

2. *Analysis.*

	By Klaproth.	By Lunn.
Oxide of copper	68·13	62·847
Phosphoric acid	30·95	21·687
Water	0·00	15·454

3. It is found in veins traversing greywacke slate, and is accompanied by several varieties of Quartz and ores of copper, in the Virneberg near Rheinbreitbach on the Rhine.

PSILOMELANE. Uncleavable Manganese-Ore. Mohs.

Regular forms and cleavage unknown. Fracture not observable.

Lustre imperfectly metallic. Color bluish-black and greyish black, passing into dark steel-grey. Streak brownish black, shining. Opake.

Brittle. Hardness = 5·0 . . . 6·0. Sp. gr. = 4·145, a botryoidal variety.

Compound Varieties. Reniform, botryoidal, fruticose: composition columnar, impalpable; fracture flat conchoidal, even; in a second curved composition it is curved lamellar, the faces of composition being smooth, rough or granulated. Massive: composition granular, impalpable, strongly connected; fracture flat conchoidal, even.

Analysis.
By TURNER.

	fr. Schneeberg.	fr. Romaneche.
Red oxide of manganese	69·795	70·967
Oxygen	7·364	7·260
Baryta	16·365	16·690
Silica	0·260	0·950
Water	6·216	4·130

The only European locality quoted, is Schneeberg, Saxony, though it probably exists at several other places. Very well characterized specimens are found in considerable quantity, at Chittenden, (Vt.)

PURPLE COPPER. (See *Phillipsite.*)

PYCNITE. (See *Topaz.*)

PYKNOTROP.

Massive: cleavage in two directions, but indistinct. Fracture splintery.

Lustre vitreous. Color greyish white, to brown and grey. Translucent.

Hardness = 2·5 . . . 3·0. Sp. gr. = 2·609 . . . 2·669.

1. It is probably a variety of Serpentine.

PYRALLOLITE. Prismatic Tabular-Spar.

Primary form. Rhombic prism. M on M = 94° 36′.

Cleavage, distinct parallel to M, also to the diagonals of the prism.

Massive: composition granular. Fracture earthy.

Lustre resinous. Color white, sometimes greenish. Translucent on the edges . . . opake.

Hardness = 3·5 . . . 4·0. It seems to become harder by exposure to the air. Sp. gr. = 2·55 . . . 2·60.

1. Before the blow-pipe, it first becomes black, then white; afterwards it intumesces and melts on its edges. With borax it yields a transparent glass. When reduced to powder, it phosphoresces, with a bluish light.

Pyrochlore.

2. *Analysis.*

By NORDENSKIOLD.

Silica	56·62
Magnesia	23·38
Alumina	3·38
Lime	5 58
Oxide of iron	0·99
Protoxide of manganese	0·99
Water	3·58
Bitumen and loss	6·38

3. It occurs at Storgard in the parish of Pargas in Finland, with Feldspar, Augite, Sphene and Calcareous Spar.

PYRANEITE. (See *Garnet.*)

PYRARGILLITE.

In crystals, which are four-sided prisms with truncated angles, and massive.

Color blackish, and shining.

Hardness = 3·5. Sp. gr. = 2 505.

It emits a clayey odor.

1. *Analysis.*

By NORDENSKIOLD.

Silica	43·93
Alumina	28·93
Protoxide of iron	5·30
Magnesia, with some protoxide of manganese	2·90
Potash	1·05
Soda	1·85
Water	15·47

2. It is found in Finland.

PYROCHLORE. Pyrochlore Eruthrone-Ore.

Primary form. Regular octahedron.

Fracture conchoidal.

Lustre resinous to vitreous. Color reddish-brown. Streak clear-brown. Opake.

Hardness = 5·0 . . . 6·0. Sp. gr. = 4·2.

Pyrochlore—Pyrolusite.

1. Alone, it becomes of a clear, yellowish brown color, and melts with much difficulty, into a blackish-brown, slaggy mass. With borax, it is perfectly dissolved in the oxidation fire, into a reddish-yellow, transparent glass, which, by flaming, becomes yellow and opake. In the reducing heat, a dark red pearl is obtained. In salt of phosphorus, it is dissolved perfectly, attended at first, with some effervescence. With soda, upon platina, it affords a green manganesious reaction.

2. *Analysis.*

By WOHLER.

Titanic acid	62·75
Magnesia	12·85
Protox. of uranium	5·18
Oxide of cerium (impure)	6·80
Oxide of manganese	2·75
Oxide of iron	2·16
Oxide of tin	0·61
Water	4·20

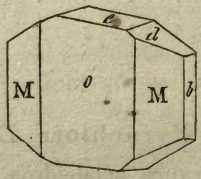
3. It is found at Friederichsväirn in Norway.

PYROLUSITE. Prismatic Manganese-Ore. HAIDINGER.

Primary form. Right rhombic prism. M on M = 93° 40′.

Secondary form.

Fig. 346.



Cleavage, parallel to M and *b*.

Lustre metallic. Color iron-black; in very delicate columnar compositions, the color becomes bluish, and the lustre imperfectly metallic. Streak black. Opake.

Pyrolusite.

Rather sectile. Hardness = 2·0 ... 2·5. Sp. gr. = 4·94, from Elgersburg; 4·819. TURNER.

Compound Varieties. Reniform coats. Both columnar and granular composition is often met with, particularly the former; the individuals often radiating from common centres. If the individuals are very delicate, the masses will soil the fingers, and write on paper.

1. Before the blow-pipe, it gives the customary reaction of manganese-ores.

2. *Analysis.*

By TURNER.

Red oxide of manganese	85·617
Oxygen	11·599
Water	1·566
Silica	0·553
Baryta	0·665
Lime	a trace.

3. Pyrolusite is very often the product of decomposition from Spathic Iron, the carbonate of iron of the latter being converted by natural agents, into the hydrate of the peroxide, while the lime, which it occasionally contains, is deposited in the shape of Calcareous Spar, or Arragonite; and the Manganese is often found covering the surface of decomposed rhomboids of the original species, in the shape of minute crystals. In this manner, it occurs in the mines of decomposed Spathic Iron, in beds in gneiss, at Hüttenberg in Carinthia, at Schwalkalden in Hessia, and other places. It is likewise found in this manner in the counties of Sayn, Siegen, Salm, and Hamm in Prussia, in the veins of Spathic Iron traversing clay slate, which are decomposed in the upper levels, and then contain much Limonite. One of the varieties from Horhausen is particularly remarkable for the delicacy of the fibres, which are disposed in small tufts, within the geodes of Limonite, and which greatly resemble the fibrous varieties of Grey Antimony. Weyer in the county of Wied-Runkel, Hirschberg near Ahrensberg and Beodorf on the Lower Rhine, are likewise quoted as localities of superb specimens of Pyrolusite. The finest crystals of Pyrolusite, occur at Schimmel and Oslerfreude near Johanngeorgenstadt, and at Hirschberg in Westphalia. These are chiefly short thick prisms, terminated on their extremities in

numerous fibres. Large flattish crystals, of great beauty, terminating in sharp elongated pyramids, with curved faces, occur at Maeskamezi, near Maggar Lapos, south of Kapnik in Transylvania, in geodes of Limonite, and associated with crystals of Quartz. Cleavable individuals, of considerable size, are found near Goslar in the Hartz, in a mountain called Gingelsberg. They are imbedded in small veins of Quartz and Calcareous Spar, in clay slate. Distinct, though small crystals, are met with in many of the mines in the west of Germany. A variety occurs at the mine of Antonio Pereira near Villa Ricca in Brazil, along with Limonite and Psilomelane. Small granular Pyrolusite occurs in Dalecarlia, Sweden. But the individuals are often much smaller, and appear in the form of a black sooty substance. Such are frequently found in the iron mines of Raschau, and other places in Saxony. The Pyrolusite is rarely found without Psilomelane; and is also very generally associated with Limonite. In some varieties from Berge in the county of Salm, thin stalactites of Limonite are uniformly covered with a stratum of Pyrolusite. Pyrolusite occurs at numerous places in England.

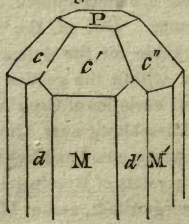
It is very abundant in the United States. It occurs at Bennington, Monkton, Chittenden, and various other places in Vermont, crystallized and granular, and associated with Psilomelane; in Massachusetts, at Conway, in a vein of Quartz; at Winchester, (N. H.); in Connecticut, at Salisbury and Kent, in thin velvety coatings, upon Limonite.

PYROMORPHITE. Brachytypous Lead-Baryte. Partsch.

Primary form. Regular hexagonal prism.

Secondary form.

Fig. 347.



Pyromorphite.

M or M′ on *d*′ - -	150°	00′	PHILLIPS.
M′ on *c*′ or M′ on *c*″ -	131	45	"
P on *c* or *c*″ - -	138	30	"
c′ on *c* or *c*″ - -	110	5	"

Cleavage, traces parallel with M, also parallel with *c*. Fracture imperfectly conchoidal, uneven. Surface, M almost always horizontally streaked, and often barrel-shaped, or contracted at the ends of the prisms. P rough, and often excavated.

Lustre resinous. Color, generally green or brown. There is an uninterrupted series from various shades of white, through siskin-green, asparagus-green, grass-green, pistachio-green, olive-green, oil-green; wax-yellow, honey-yellow, orange-yellow; aurora-red, hyacinth-red; hair-brown, clove-brown; pearl-grey and ash-grey. Streak white, sometimes inclining to yellow. Semi-transparent... translucent on the edges.

Brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 7·098, of a green variety from Zschopau; 6·831, of a brown variety from Zimapan.

Compound Varieties. Globular, reniform, botryoidal, fruticose shapes; composition columnar; faces of composition rough, irregularly streaked, seldom smooth. Massive: composition columnar, or granular; the latter in most cases strongly coherent.

1. The green and brown varieties are separated by some mineralogists into distinct species, without sufficient reason, however, inasmuch as there are individuals whose properties form an uninterrupted series of connexion between the two.

2. Before the blow-pipe, on charcoal, it melts in the outer flame into a globule, which crystallizes on becoming cold, and changes to a brown

Pyromorphite.

color. In the interior flame, the globule becomes bluish, is luminous when hot, and on cooling crystallizes with large facets of a lighter color, approaching the mother of pearl. The form produced by this crystallization has not been accurately examined, though it appears to be a regular composition of several individuals. With borax, salt of phosphorus and soda, it behaves like the oxide of lead. With boracic acid and iron, it affords phosphate of iron and metallic lead.

3. *Analysis.*

	By Klaproth. from Zschopau, Saxony.	By Wohler.
Oxide of lead	78·58	82·287
Phosphoric acid	19·73	15·727
Muriatic acid	1·65	1·986
Oxide of iron	0·00	0·10	a trace.

By Kersten.

Locality.	Sp. gr.	Chloride of Lead.	Fluoride calcicum.	Phos. of lime.	Phos. of lead.	Oxide of iron.	Total.
Sonnenwirbel	6·092	10·838	1·094	11·053	77·015	0·00	100·000
Mies (mas've)	6·444	10·642	0·248	7·457	81·451	trace	99·998
do. (crystals)	5·983	9·664	0·219	0·848	89·268	0·00	99·999
Bleisdadt (do.)	7·009	9·918	0·137	0·771	89·174	0·00	100·000
England (do.)	0·000	10·074	0·130	0·682	89·110	0·00	99·996
Poullaouen (do.)	7·048	10·090	0·000	0·000	89·910	trace	100·000
do. (mas've)	7·050	10·069	0·000	0·000	89·931	trace	100·000

4. It is found in veins in various rocks, usually attended by Galena, various salts of lead, Blende, Fluor and Quartz; sometimes also by different ores of silver.

Finely crystallized varieties are found at Zschopau, and other places in Saxony; at Przibram and Mies in Bohemia; in various parts of England, and at the lead hills of Scotland; also in Siberia. The brown varieties occur at Poullaouen and Huelgoet in Brittany, at Wanlockhead in Scotland, at Mies and Bleistadt in Bohemia.

In the United States, handsome specimens of the green varieties, have been found at the Perkiomen lead mine near Philadelphia, and at the lead mine in Lenox, (Maine.)

Pyrope. (See *Garnet.*)

PYROPHYLLITE.

1. Heated before the blow-pipe, it swells up, but is infusible. It yields moisture by calcination; the residue being heated with solution of cobalt, asumes a blue color.

2. *Analysis.*

Silica	59·79
Alumina	29·46
Magnesia	4·00
Oxide of iron	1·80
Water	5·62
Silver	a trace.

3. It is brought from the Ural mountains.

PYROPHYSALITE. (See *Topaz.*)

PYRORTHITE.

Massive: composition columnar. Fracture conchoidal, splintery, earthy.

Lustre resinous. Color brownish-black; if decayed, yellowish-brown. Streak brownish-black. Opake.

Hardness, is scratched by Calcareous Spar. Sp. gr. = 2·19.

1. If gently heated on one side, it takes fire, and burns without either flame or smoke; after which, it becomes white, and melts into a black enamel. It gives a transparent glass with borax; and is soluble in heated acids, with the exception of a black powder.

2. *Analysis.*
By BERZELIUS.

Silica	10·43
Alumina	3·59
Protoxide of cerium	13·92
Protoxide of iron	6·08
Yttria	4·87
Lime	1·81
Protoxide of manganese	1·39
Water	26·50
Carbon	31·41

3. It has been found at Kärarf, near Fahlun in Sweden, in a variety of granite, accompanied by Gadolinite.

PYROSIDERITE. (See *Limonite.*)

PYROSMALITE. Hexagonal Pyrosmalite-Mica. BREITHAUPT.

Primary form. Regular hexagonal prism.

Cleavage, parallel with the bases of the primary form, perfect. Fracture uneven.

Lustre pearly upon the bases of the six-sided prism; lower degrees of vitreous lustre in other directions. Color pale liver-brown, passing into grey and green. Streak paler than the color. Translucent . . . opake.

Rather brittle. Hardness = 4·0 . . . 4·5. Sp. gr. = 3·077 . . . 3·173.

1. Before the blowpipe, it becomes reddish brown, and developes fumes of muriatic acid. In a strong fire, it melts first into a black scoria, and then into a globule, which is attractable by the magnet. It is easily soluble in glass of borax.

2. *Analysis.*

By HISINGER.

Silica	35 850
Protoxide of iron	21·810
Protoxide of manganese	21·140
Muriate of iron, with excess of base	14·095
Lime	1·210
Water	5·895

3. It occurs in the iron mines of Nordmark, in Wermeland in Sweden, associated with Calcareous Spar and Pyroxene.

PYROXENE. Paratomous Augite-Spar. MOHS.

Primary form. Oblique rhombic prism. M on M = 87° 5′. (87° 42′.)

Pyroxene.

Secondary forms.

Fig. 348.

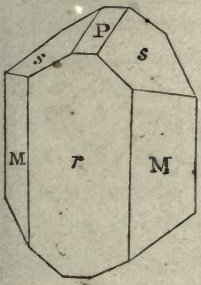
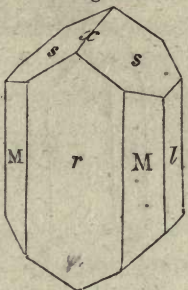


Fig. 349.



Etna.

Fig. 350.

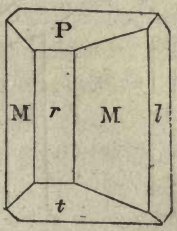


Fig. 351.

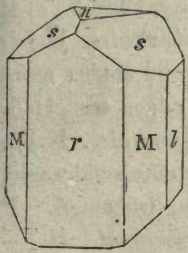
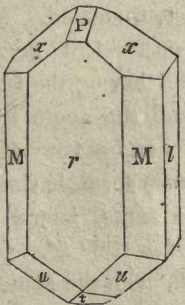
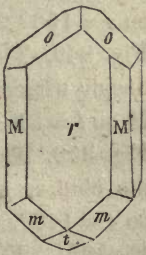


Fig. 352.



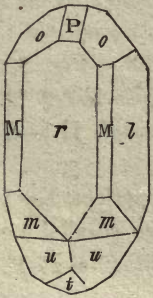
Bytown, (L. Canada.)

Fig. 353.



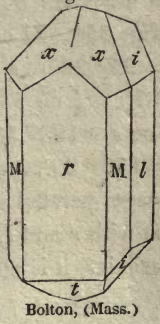
Canaan, (Conn.)

Fig. 354.



Canaan, (Conn.)

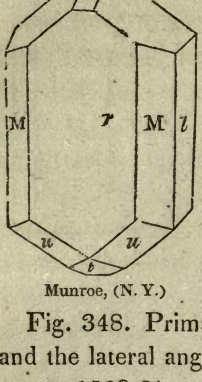
Fig. 355.



Bolton, (Mass.)

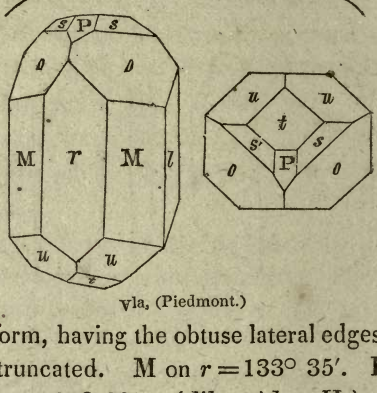
Pyroxene.

Fig. 356.



Munroe, (N. Y.)

Fig. 357.



Vla, (Piedmont.)

Fig. 348. Primary form, having the obtuse lateral edges, and the lateral angles, truncated. M on $r = 133° 35'$. P on $s = 150° 2'$. s on $s = 120° 38'$. (*dihexaèdre.* H.)—Fig. 349. The same, having the lateral solid angles more deeply truncated, and the acute lateral edges truncated. M on $l = 136° 15'$. s on $l = 138° 48'$. (*triunitaire.* H.)—Fig. 350. The primary form, having the acute solid angle, the obtuse, and the acute, lateral edges, truncated. P on $t = 148°$. r on $t = 106° 6'$. (*quadrioctonal.* H.)—Fig. 351. Fig. 349, with the acute solid angles replaced by single planes. n on $r = 90°$.—Fig. 352. r on $t = 106° 6'$. u on $u = 131° 8'$. x on $r = 126° 36'$. M on $x = 134° 17'$.—Fig. 353. M on $o = 145° 9'$. o on $r = 118° 59'$. o on $o = 95° 28'$. r on $m = 133° 30'$.—Fig. 355. i on $l = 139° 7'$. i on $i = 81° 46'$. (*épéméride.* H.)—Fig. 356. r on $s = 103° 59'$. (*octoduodecimal.* H.)—Fig. 357. o on $s = 156° 39'$. (*stenonome.* H.)

Cleavage, parallel with M, rather perfect, but interrupted; also with r and l, and sometimes parallel with s. In some varieties, it is eminent in the direction of P. Frac-

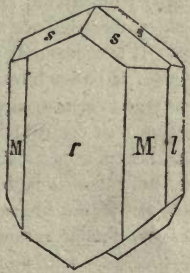
ture conchoidal, sometimes perfect . . . uneven. Surface, *r* striated vertically, P sometimes rough.

Lustre vitreous, inclining to resinous. Color green, often inclining to brown, and passing into grey and white, and also into black. Streak white . . . grey, corresponding to the color. Transparent to opake.

Brittle. Hardness = 5·0 . . . 6·0. Sp. gr. = 3·349, an ash-grey variety.

Compound Varieties. Twin-crystals: face of composition parallel, axis of revolution perpendicular to *r*.

Fig. 358.



Sometimes crystals of this kind are in cruciform aggregations. Massive varieties, compound in the direction of P, as in Sahlite; this must not be taken for cleavage, as it does not continue throughout the whole mass, but only produces more or less thick laminæ, often separated from each other by some extraneous substance: it often possesses a slight pearly lustre: there is also composition parallel *r*, as in Mussite. Massive: composition granular, of various sizes of individuals, often but slightly cohering, but often also, very intimately connected; faces of composition rough. The individuals of lamellar and columnar varieties, are in

most cases easily separated, and present striated faces of composition.

1. The present species embraces a large number of varieties, both simple and compound, among which there exist uninterrupted transitions. *Augite* comprehends opake varieties, the colors of which are black, or blackish green. One of its subdivisions, *foliated* Augite, occurs in imbedded crystals. *Conchoidal* Augite refers to imbedded grains, whose fracture is perfectly conchoidal; *common* Augite occurs also in grains, but having an uneven fracture. Foliated Augite is transformed, by decomposition, into those earthy masses, which have been called crystallized green-earth. *Coccolite* is of rather paler shades of green colors than the preceding varieties, and consists of very distinct granular particles of composition, which may be easily separated. The colors of *Sahlite*, are generally paler green, and inclining to grey; it is faintly translucent on the edges, though there are some varieties of it, as black and opake as Augite. It is compound, parallel to the face of P. If the colors become very pale, it passes into *Diopside*, which contains greenish grey, greenish white, &c. semi-transparent, crystals, or massive varieties, also of pale colors, and compound parallel to the face of *r*. *Baikalite* cannot be distinguished from Sahlite, even by such slight marks as those just quoted, and *Fassaite* is the name of those varieties which unite the green colors of Sahlite, or some that incline still more to yellow, with crystalline forms similar to those of Diopside. *Omphazite* is a compact, leek-green variety, with an imperfectly conchoidal or splintery fracture, and generally mixed with Garnet. That variety, called *Green Diallage*, is grass-green, either crystallized or massive, and in the latter case, it presents a granular structure, or is compound parallel to P, or to *r*, alternating in layers, with particles of Hornblende of the same color. Very delicate crystals produce a kind of Asbestus, which is different from the one in connexion with Hornblende, and different also from Picrolite and Picrosmine.

2. Before the blowpipe, it melts pretty easily, and emits a few bubbles; it finally yields a glassy globule, more or less intensely colored by iron. It is readily dissolved by borax. Several varieties of the present species have been obtained by way of fusion. Black crystals are not unfrequent among the slags from the iron furnaces of Sweden. A white variety, in perfect crystals, has been obtained by mixing silica, lime and magnesia, in the necessary proportion, and exposing the mixture, in a charcoal crucible, to the heat of porcelain furnaces. Many varieties of

Pyroxene.

Pyroxene, if melted, and then allowed to cool slowly, crystallize and assume an appearance little different from what they had before.

3. *Analysis.*

Analysts.	Varieties, and localities.	Magnesia.	Silica.	Alumina.	Lime.	Oxide of iron.	Ox. of manganese.	Water.	Total.
Laugier.	*Diopside.* Piedmont.	18·25	57·50	0·00	16·50	6·00	0·00	0·00	98·25
Lowitz.	*Baikalite.*	30·00	44·00	0·00	20·00	6·00	0·00	0 00	100·00
Rose.	Black. Orijerwi.	18·00	54.64	0 00	24·94	1·08	2·60	0·00	100·26
"	Langbanshytta.	16·99	55.32	0·00	23.01	2·16	1·59	0·00	99 07
Vauquelin.	" Etna.	10·00	52·00	3·33	13 20	14·66	2·00	0·00	95·19
Klaproth.	" Rhöngebirge.	12·75	52·00	5·75	14·00	12 25	0·25	0·25	97·25
"	" Frescati.	8·75	48·00	5·00	24·00	12·00	1·00	0·00	98·75
Bonsdorff.	White. Tammara.	18·55	54·83	0·28	24·76	0·99	trace.	0·00	99·41
Hisinger.	Langbanshytta.	17·81	54·18	0·00	22·72	2·18	1·45	0·00	98·34
Nordenskiöld.	Bluish green. Pargas.	22·57	55 40	2·83	15·70	2·50	0·43	0·00	99·43
"	Brown. "	12·01	51·80	6·56	19·07	6·92	0·00	1·02	97·38
Vauquelin.	*Coccolite.*	10·00	50·00	1·50	24·00	7·00	3·00	0·00	95·50

4. Pyroxene occurs in imbedded crystals, in various kinds of rocks, in basalt, lava, &c.; also in beds in older rocks, both in crystals and in compound massive varieties; it enters into the regular mixture or composition of several rocks, as the pyroxene rocks, some varieties of greenstone and basalt; it is likewise found in veins, traversing primitive rocks. Fo-

Pyroxene.

liated, conchoidal, and common Augite, are found in the first kind of these repositories; granular Augite, Coccolite and Sahlite, occur in the second, and are associated with ores of iron and titanium, Hornblende, Epidote, Feldspar, Scapolite, &c. Omphazite occurs in beds, with Quartz, Garnet and Hornblende; Diopside in veins, traversing serpentine, with Garnet and Mica; and Fassaite and Baikalite also seem to occur in veins, when they are accompanied by Limestone.

5. The imbedded varieties of Augite are found almost in every kind of basalt, and those rocks which are allied to it. The largest crystals occur near Aussig in Bohemia; but it is met with also in the Rhön and Vogel mountains in Germany, in France and Italy, in Scotland and its western islands, &c. Granular Augite and Sahlite are chiefly obtained from Arendal in Norway, and Sahla in Sweden; Baikalite from the mouth of the Sljamanka river, that falls into lake Baikal. Diopside is found in Piedmont; Fassaite in the valley of Fassa in the Tyrol, and in the Bannat of Temeswar; Omphazite in the Saualpe in Carinthia, and near Hof in Bayreuth. The beautifully green varieties of granular Pyroxene occur in the Bacher mountain in Lower Stiria; the crystallized green-earth in the valley of Fassa in the Tyrol. The black mineral found in certain meteoric stones, appears to belong to the present species.

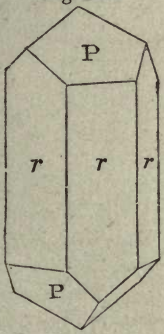
One of the most interesting localities of Pyroxene in North America, is at Bytown, Lower Canada, where it occurs, in white semi-transparent crystals, disseminated through Calcareous Spar: the crystals are an inch in diameter, and one and a half inches long, of the form of Fig. 352. The cleavage parallel with P is effected with perfect facility, and the whole crystal streaked parallel with that face. Handsome crystals of Diopside occur in the limestone quarry of Bolton, (Mass.); and very distinct crystallizations of dark green Augite and Sahlite have been found in veins at the iron-mine of Munroe, (N. Y.) Black crystals occur in the trap of Montreal. The white variety, in large, though often imperfect forms, abounds at Canaan, (Conn.) in the Dolomite beds; also at Kingsbridge, (N. Y.) with white Hornblende. Massive Sahlite, in large individuals, abounds at the Verd Antique quarries of West Haven and Milford, (Conn.); also at Bolton, (Mass.): at the latter place, masses compound in the direction of P and *r*, at the same time, are sometimes observed. A dark green imperfectly crystallized Pyroxene, abounds at Rogers' Rock upon lake George, near Ticonderoga, (N. Y.) where it is imbedded in Feldspar, and associated with Sphene and Plumbago. Coccolite, of a handsome green color, exists at Willsborough, (N. Y.) in a vein with granular Garnet and Tabular Spar. Granular Pyroxene exists also at Munroe, (N. Y.)

QUARTZ. Rhombohedral Quartz. Mohs.

Primary form. Rhomboid. P on P = 94° 15′.

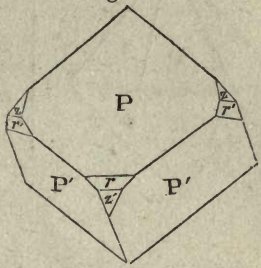
Secondary forms.

Fig. 359.



Compostella, (Spain.)

Fig. 360.



Chesterfield, (Mass.)

Fig. 361.

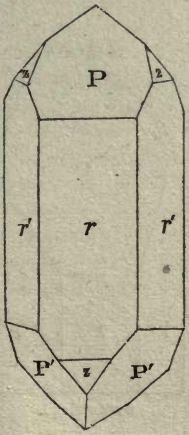
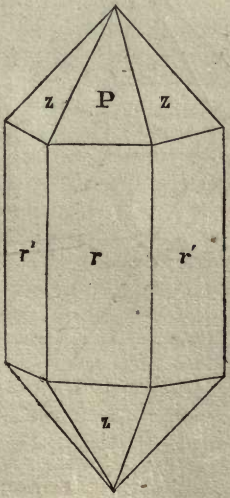


Fig. 362.



Quartz.

Fig. 363.

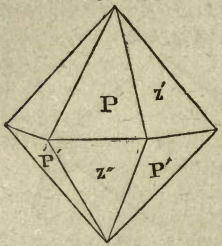
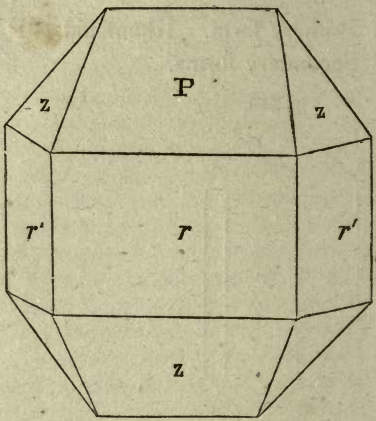
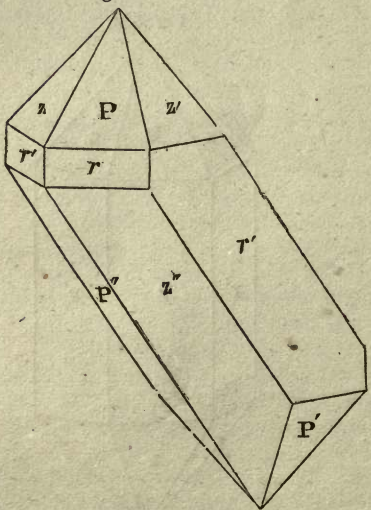


Fig. 364.



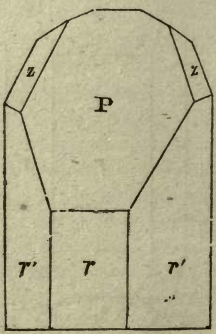
Paris, (Me.)—Fairfield, (N. Y.)

Fig. 365.



Fairfield, (N. Y.)

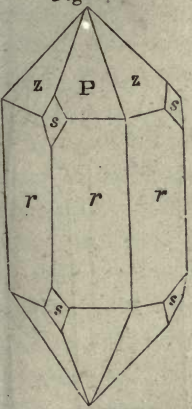
Fig. 366.



Switzerland.

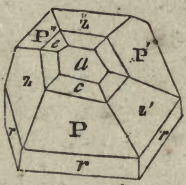
Quartz.

Fig. 367.



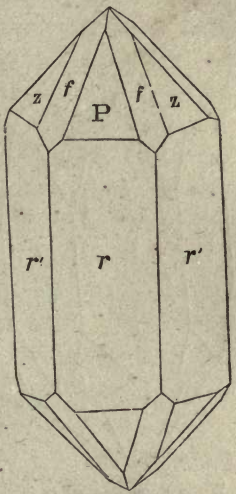
Fairfield, (N. Y.)

Fig. 368.



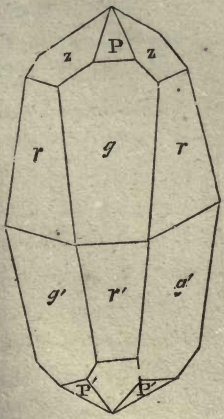
Fairfield, (N. Y.)

Fig. 369.



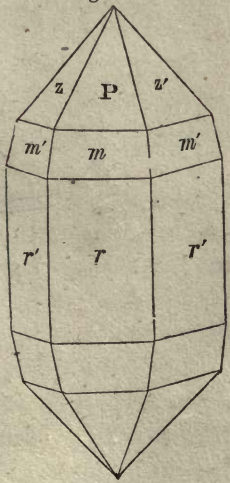
Quebec.

Fig. 370.



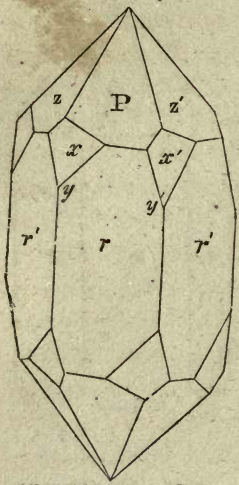
Alps.

Fig. 371.



Quartz.

Fig. 372.



White Mountains, (N. H.)

Fig. 373.

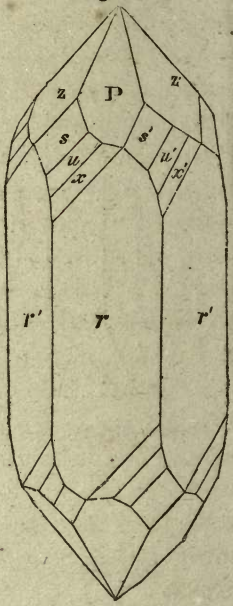
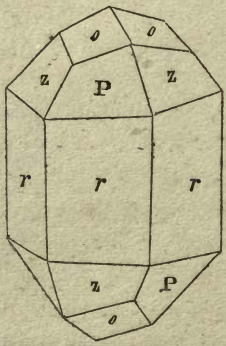


Fig. 374.



Quebec.

Fig. 359. The primary form, having its lateral angles deeply truncated, so as to produce a long prism. P on r $=141° 40'$.—Fig. 360. The primary form, having its lateral angles replaced by tangent planes, (r,) and by triangular planes resting on the upper edges of the rhomboid. P on $z=133° 48'$. r on $z=141° 40'$.—Fig. 361. The same, in which the planes r are much extended. (*prismé bisalterne.* Hauy.) A common form.—Fig. 362. The same, in which the planes z have the same size with P. (*prismé.* Hauy.) A common form, but rarely perfectly regular in the size of similar planes.—Fig. 363. The same as Fig. 361, with the omission of r. P on $z''=103° 20'$. (*dodécaèdre.* Hauy.) Rare.—Fig. 364. Similar to Fig. 361, but having two opposite sides of the prism, and the adjacent pyramidal faces unduly extended. (*prismé comprimé.* Hauy.) Not very common.—Fig. 365. Similar to Fig. 363, but having two adjacent faces of the prism unduly extended. (*prismé sphalloide.* Hauy.)—Fig. 366. Similar to Fig. 361, but having one face of the pyramid unduly extended. (*prismé haloide.* Hauy.) Common.—Fig. 367. Similar to Fig. 361, with the addition of the rhomboidal truncations of the alternate lateral, solid angles. r on $s=142°$. P on $s=151° 7'$. Common.—Fig. 368. P on $a=145° 22'$. c on $a=159° 50'$. c on P $=165° 30'$. z'' on $a=111° 15'$. z on $a=137° 51'$. z on e $=145° 30'$. a on $e=175° 30'$. Very rare.—Fig. 369. Fig. 361, having the edges of the pyramids truncated. f on $z=141° 40'$. (*emarginé.* Hauy.) Very rare.—Fig. 370. r' on $g=178° 32'$. P on $g=143° 32'$. (*hyperoxide.* Hauy.)—Fig. 371. Fig. 361, with the terminal edges of the prism replaced by single planes. r on $m=168°$

49′. P on $m = 152° 51′$. (*pentahexaèdre.* Hauy.) Rare. —Fig. 372. r on $x = 167° 56′$. z on $x = 125° 11′$. P on $x = 148° 42′$. (*plagièdre.* Hauy.) Rare.—Fig. 373. Similar to Fig. 372, with the addition of the rhomboidal truncations of Fig. 367, and the replacement of the edges between s and x; s and $x = 152° 13′$. u on $x = 173° 33′$. (*co-ordonneé.* Hauy.) Very rare.—Fig. 374. P on $o = 160° 15′$. o on $o = 125° 10′$. Very rare.

Irregular forms and grains.

Cleavage, parallel to P and r; but very imperfect, and interrupted by conchoidal fracture. Fracture conchoidal, sometimes highly perfect, sometimes less distinct. Surface, a and x generally rough; r and z are streaked horizontally. The rest of the faces generally smooth.

Lustre vitreous, inclining in some varieties to resinous. Color, white, prevalent; among the brightest colors are violet-blue, rose-red, clove-brown and apple-green. Dark brown and green colors, generally owing to foreign admixtures. Streak white. Transparent . . . translucent, frequently even opake, particularly when impure.

Hardness = 7·0. Sp. gr. = 2·690.

Compound Varieties. 1. Faces of composition parallel, axis of revolution perpendicular to a face of r; the individuals being continued beyond the face of composition. 2. Individuals joined perpendicular to the axis. Frequently large crystals are made up of alternatiug laminæ of two individuals; and often, faces of composition assume the appearance of cleavage.

Implanted globules, reniform, stalactitic shapes: surface smooth, granulated, or drusy; composition columnar, generally impalpable; often a second time composed into gran-

ular or curved lamellar masses. Massive: composition granular or columnar, and often impalpable; and then the fracture becomes conchoidal and splintery. Sometimes a second composition produces indistinctly granular, or thick lamellar masses. Certain very thin columnar compositions, if cut *en cabochon* parallel to the fibres, show an opalescent light. Pseudomorphic crystals, in the shape of cubes, octahedrons, derived from Fluor,—in the shape of rhomboids and hexagonal prisms, derived from Calcareous Spar,—and of lenticular forms, from Gypsum. Globular and tuberose masses formed in vesicular cavities. Plates. Pebbles.

1. There are several modes of occurrence among the crystals of Quartz, hitherto confined to this species, which become evident on an inspection of the forms described above. The scalene triangular faces *x* and *u* are the most remarkable in this respect. Their faces appear only to the right, or only to the left of the faces *s*. Two individuals, differing in regard to the right or left situation of these faces, cannot be brought in any such position, that all their faces become parallel; and they are different, therefore, like the right hand and the left. This difference extends even to the action of the individuals on light, as has been shown by Mr. Herschel.

2. The species Quartz does not by any means abound in varieties of crystallization; and yet, owing to the disproportionate size of the faces of its forms, its crystals offer considerable diversity of appearance. The chief perplexity among the varieties of Quartz, arises from mechanical composition, and the admixtures of different substances foreign to the species. No less than thirteen different species are distinguished in the Wernerian system, to which those of other systems more or less correspond. *Quartz* contains most of its simple or crystallized varieties, and may be said to represent the species most perfectly. It contains five sub-species;—*Amethyst*, including violet-blue varieties; *Rock Crystal*, composed of the most perfectly crystallized, and some transparent, or semi-transparent, massive varieties; *Rose Quartz*, confined to translucent rose-red, and milk white, massive varieties; *Prase*, which is only of a dark leek-green color; and *Common Quartz*, at last, comprehends all those varieties, not included in any of the preceding subspecies.

Quartz.

There are several massive varieties of common quartz, which consist of granular particles of composition. If they diminish so much in size as to become impalpable, their transparency and lustre becomes diminished, and several kinds of conchoidal fracture appear, if specimens of these varieties be broken. This gave rise to new species among the early mineralogists. *Hornstone* is always compound, translucent on the edges, and either of a splintery dull fracture, or glistening and glimmering, and conchoidal. Thus *splintery* Hornstone and *conchoidal* Hornstone, are formed, and either of them may produce *Woodstone*, if it appears in the shape of petrified wood. The varieties of *common Flinty slate* are most like Hornstone, but show on a large scale, an imperfect slaty fracture, and various dirty grey colors; those of *Lydian stone*, which form the second kind of flinty slate, possess an even, glimmering fracture, and a greyish-black color. Flint is a compound mineral, like the two preceding ones, but translucent, at least on the edges, and possesses a perfect, flat conchoidal, glimmering fracture. *Float-stone*, a variety of Quartz, which has likewise been considered as a particular species, consists of a delicate tissue of minute crystals, visible under a powerful magnifier, and demonstrates hornstone and flint, (into which it insensibly passes, by having its grain closer, and of which it often contains nodules,) to be varieties of the same natural-historical species. Common Quartz is sometimes found in reniform and stalactitic shapes, consisting of granular particles of composition, sufficiently large to be observed and separated from each other. If the thickness of these individuals be so much diminished, that at last they become impalpable, the different varieties of Calcedony are formed, occurring in the above mentioned external shapes. The difference in the colors of these, has given occasion to the distinction of *common Calcedony*, and of *Carnelian;* the former of which comprehends greyish colors, or in general such as do not possess bright tints of colors, while the latter refers to red colors. *Common Carnelian*, moreover, occurs in globular and irregular tuberose shapes; *fibrous Carnelian* is found in reniform masses, and generally shows, very distinctly, the above mentioned composition. The rhomboidal crystals, of smalt blue color, from Transylvania, are also enumerated among the varieties of common Calcedony; probably because there exist reniform varieties of common Calcedony, possessing the same color, though they are more nearly related to common Quartz. Common Quartz also occurs in massive varieties, showing columnar composition. If they be thin, parallel, strongly coherent, and more or less bent, *Fibrous Qnartz*, (a par-

ticular species of the old systems,) is formed; *Cat's eye*, (another species,) if they are nearly impalpable, and almost solely to be observed in the opalescent light, which they exhibit when cut into a convex surface. *Cat's eye* is generally greenish grey; but there are varieties of other shades, sometimes even black. It preserves a small conchoidal fracture, and is more or less translucent. If several of the preceding varieties are distinctly colored by some foreign mineral substance, or intimately mixed with it, various other pretended species are formed. *Chrysoprase* is a variety of common Quartz, consisting of small granular particles of composition, colored apple green by oxide of nickel; *Plasma* is a variety of Calcedony, colored leek-green, and almost grass green, by some substance which is not exactly ascertained. *Heliotrope*, likewise a variety of Calcedony, but mixed and colored by green earth, containing blood-red spots of Jasper. The brownish-red color of the commonly so called *Hyacinth of Compostella*, is produced by the admixture of oxide of iron. If the same thing takes place in compound varieties, the individuals of which are still recognizable, *Iron Flint* is produced; and *Jasper*, with its various kinds, is formed, if besides the oxide of iron, clay enters into the mixture; and if, moreover, the individuals can, on account of their diminutive size, be no longer recognized. *Striped Jasper* probably contains a good deal of clay, and is distinguished on account of its striped delineations. The varieties of *Egyptian Jasper*, both *Red* and *Brown*, occur in globular shapes; the latter of which are, beyond a doubt, formed in open spaces, as appears from the concentric layers of which they consist, and the drusy cavities lined with crystals of Quartz, often found in their interior. *Agate Jasper*, being less impure, is more properly referred to Hornstone. *Opal Jasper* may be said to be a variety of Opal, and does not belong to the present species; nor does *Porcelain Jasper*, which is nothing else but burnt clay.

3. Quartz is infusible before the blow-pipe, on charcoal, but with soda it is easily dissolved, with effervescence.

4. *Analysis.*

The most perfect varieties of Quartz, consist of pure silica. Bucholz obtained 99·375 of silica from Rock crystal, with traces of iron and alumina. Hornstone, Flint and Calcedony, agree with it according to various analyses. Several varieties contain small quantities of alumina, lime, oxide of iron, &c. Chrysoprase contains 0·01 of oxide of Nickel, according to Klaproth. Crystals of Quartz may be obtained as deposits from a solution of silica in fluoric acid, or in potash diluted

with water. The fluid from which crystals of this species are formed in geodes and other natural cavities of rocks, has been observed to be chiefly water; and often leaves behind it a mass resembling Opal on desiccation, when suddenly exposed to the air.

5. Common Quartz enters into the regular mixture of various rocks, of granite, gneiss, mica-slate, topaz-rock, &c. In others, they occur in single crystals, and in grains, as, for instance, in porphyry, and are frequently met with in vesicular cavities, particularly of amygdaloidal rocks. Here also are found the finest varieties of Calcedony, Carnelian, of the brown, and probably also the red, Egyptian Jasper, the agate balls, &c. Hornstone frequently forms globules in compact limestone; and Flint, globular and tuberose masses in chalk, often disposed in beds, and including petrifactions. Many varieties occur in irregular nodules and large massive concretions, in various rocks. Thus common quartz is found in all those rocks, into whose composition it enters as an ingredient, sometimes forming masses, whose interior is lined with crystals. Hornstone and Chrysoprase occur in serpentine rocks, and Fibrous Quartz and Cat's eye in some varieties of slate. Quartz also forms beds by itself, as in quartz-rock and certain kinds of sandstone. It is very frequent in all kinds of veins, where are found for the most part Amethyst, rock crystals, Hornstone and Calcedony, but chiefly common Quartz, constituting the greater part, and sometimes the whole body of the vein. The agate veins are thus found, which consist of different varieties of Quartz, alternating in various stripes or bands with each other. Rock Crystal, Amethyst, Flinty Slate, but particularly common Quartz, are found in pebbles. The river sand, and that of deserts, consists of common Quartz. It is also found filling up the space of petrified bodies, as, for instance, echinites in chalk, and petrified wood in sandstone, and in alluvial deposites.

6. The numerous varieties of the present species are spread all over the globe, but some of the most distinguished varieties are found only in a few localities. The finest and largest rock crystals are found in the Alps of Salzburg, the Tyrol, Switzerland, Dauphiny, Piedmont, and Savoy;* also in the isle of Madagascar, Ceylon and Brazil. Several vari-

* About one hundred years ago, a great drusy cavity, lined with crystals of this species, was opened in Zinken, which afforded 1000 cwt. of rock crystals, and at that early period sold for $30,000. One crystal weighed eight cwt., others from four to five cwt.

eties from Hungary and Siberia, are pale violet blue; some, called smoky-topaz, from Bohemia, are brown and yellow. The Scottish Cairngorm-crystals, sometimes possess several bright tints of these colors, in one and the same specimen. Amethysts, of various colors, are brought from Brazil; but the finest, violet-blue colors, come from Ceylon, India, and Persia, where some of them are found in pebbles. Less transparent or well colored specimens, occur in original repositories, at Porkura and other places in Transylvania, in Hungary, Siberia, &c. Some varieties are also found in Scotland, in Saxony, in the Hartz, in Bohemia, in Silesia, &c.; and they are met with in veins, in agate balls, or in secondary deposits. Rose Quartz occurs at Rabenstein near Zwiesel in Bavaria, and in Siberia; the milk-white varieties of it are known from Norway, Spain, France, &c. The locality of Prase, is Breitenbrunn in the mining district of Schwarzenberg in Saxony. Smalt blue Calcedony, sometimes crystallized, occurs at Tresztyan in Transylvania; the stalactitic and reniform shapes, occur in fine varieties in Iceland and the Faröe islands, in amygdaloid; at Hüttenberg and Loben in Carinthia, in beds of iron-stone: also in Hungary, Transylvania, in Scotland and other countries. Most beautiful specimens have been found in Trevascus mine in Cornwall. Carnelian is brought from Arabia, India, Surinam, and Siberia; it is met with also in Bohemia, Saxony, &c.; fibrous Carnelian, in Hungary; Chrysoprase, at Kosemütz in Silesia, in serpentine. It is not known from whence the ancients received the Plasma found among the ruins of Rome; but several varieties, resembling it, have been recently discovered in Moravia and Bavaria. It occurs in India, from whence it is occasionally brought in beads and other ornaments. Flint is a common mineral in England, France, the islands of Rügen and Seeland, in Poland and Spain. Near Gratz in Stiria, it occurs as one of the ingredients of gneiss. Splintery Hornstone produces the remarkable pseudomorphic crystals from Schneeberg in Saxony; it also occurs in veins in Hungary and other mining countries; in beds, it is found in Norway, and in spheroidal masses in limestone in the Tyrol. Flinty slate forms beds in numerous countries. Fibrous Quartz occurs in the Hartz; Cat's eye in Ceylon, the coast of Malabar, and also in the Hartz. Heliotrope used formerly to be brought from Ethiopia, but is now generally obtained from Bucharia, from Tartary and Siberia. Iron-flint is frequent in the iron-stone veins of Saxony, Bohemia, Hungary, Transylvania, &c.; and along with it, often also, common Jasper. Striped Jasper occurs in Siberia, at Grandlsteen in Saxony, at Ivybridge in Dev-

onshire; the brown Egyptian Jasper comes from the banks of the Nile; the red variety, from Baden. The petrifactions, still preserving the rings of wood, in the shape of trunks, branches and roots, are met with in many countries, particularly in Hungary, and Antigua in the West Indies. Rare crystallizations of Quartz occur in the black limestone of Quebec; and large crystals of smoky Quartz are brought from Nova-Scotia.

The United States have not afforded very remarkable varieties of Rock crystal. The primitive mountains of New Hampshire and Vermont, produce occasionally large crystals of this variety; but their occurrence is rare. The transition limestone of New York affords at numerous places, very beautiful crystals, chiefly of the form represented in figs. 362, and 367, and which vary in dimensions from four inches in diameter, down to the smallest size. Occasionally they are somewhat smoky, and are often penetrated by anthracite. One of the oldest localities, is Diamond Island, Lake George; but that which still affords them in the greatest abundance, is Canada Creek, near Fairfield, St. Lawrence county. The granite of Chesterfield, (Mass.) contains small crystals, like fig. 360, in which scarcely any faces, excepting those belonging to the primary rhomboid, are visible. The faces are destitute of polish. The trap region of Massachusetts and Connecticut, occasionally affords the Amethyst; loose crystals of which are also found in the soil, near Bristol, (R. I.) The notch of the White Mountains, (New Hampshire,) and the Tourmaline deposit of Paris, (Me.) have both afforded handsome crystals of brown or smoky Quartz. Iron-flint occurs at Pittsfield, (Mass.) Druses of Quartz crystals, colored of a delicate apple green, occur along with Chrysoprase, at New Fane, (Vt.); Prase, at Cumberland, (R. I.); Rose Quartz, at Paris, (Me.) Southbury, (Conn.) Acworth, (N. H.); leek-green Hornstone, in rolled masses, at Amherst and Pelham, (Mass.); common Hornstone, throughout the secondary region of New York, Ohio, and other western states. Calcedony and Carnelian occur, though rarely, forming agate, throughout the trap region of Connecticut and Massachusetts; Red Jasper, at Saugus near Boston, and yellow Jasper, with Calcedony, at Chester, (Mass.); the latter found in large rolled masses. Pseudomorphous crystals, consisting of coatings over six-sided prisms, and scalene dodecahedrons, of Calcareous Spar, are found in a galena vein, at Williamsburgh, (Mass.)

7. Several varieties of Quartz are of important use in the arts and manufactures. Those possessing good degrees of transparency, or fine

colors and delineations, as Rock crystal, Amethyst, Rose Quartz, Chrysoprase, several varieties of Calcedony, called Onyx, Sard, Sardonyx, &c., are cut and polished into ring stones, seals, and various other ornaments. Agate is also used for the same purposes. The most important application, however, is that for the manufacture of glass, and pottery. It is used also as a flux in the melting of several kinds of ores. Its use in gun locks is also well known. Sandstones yield various applications for architectural and other purposes, as the construction of melting furnaces, mill-stones, &c. Sand, with slaked lime, forms mortar.

Quincyte.

Massive; composition granular.

Color carmine-red.

1. It loses its color by heat, and is with difficulty fusible before the blow-pipe.

2. *Analysis.*

By Berthier.

Silica	54·00
Magnesia	19·00
Protoxide of iron	8·00
Water	17·00

3. It is found in the fresh water limestone of Mehun and Quincy, in the department of Cher.

4. The description is too imperfect, to lead to any opinion of its specific character.

Radiolite.

Massive: composition columnar, particles of composition radiating: compact. Cleavage, distinct in one direction.

Lustre silky, glistening. Color white.

Hardness, above Fluor. Sp. gr. = 2·275 . . . 2·286.

1. *Analysis.*

By Hunnefield.

Silica	41·88
Alumina	23·79
Soda	14·07
Potash	1·01
Water	1·00
Oxide of iron	0·91
Carbonate of lime	2·50
Gangue	5·50

2. It is found at Eckefiord in Norway.

Realgar.

RATOFKITE.

An earthy, impure variety of Fluor, which, according to JOHN, consists of

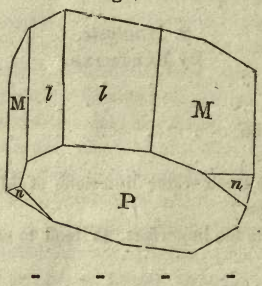
Fluate of lime	49·00
Phosphate of lime	20·00
Sulphate of lime	2·00
Phosphate of iron	3·75
Water	10·00
Insoluble matters	6·25

REALGAR. Red Malacone-Blende.

Primary form. Oblique rhombic prism. M on M= 74° 14′.

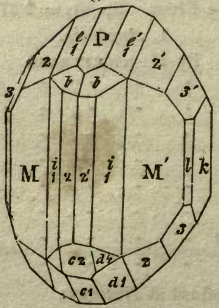
Secondary forms.

Fig. 375.



M on M	74°	30′
l on *l*	113	20
P on *l*	113	16
n on *n* over P	131	59

Fig. 376.



Realgar.

PHILLIPS.

M on M	74°	15′	M′ on *e*′2	135°	2′
P on M	104	6	M′ on *e*′3	141	20
P on *b*	149	12	M′ on *i*1	172	6
P on *c*2	80	00	M′ on *i*2	160	42
P on *e*1	156	30	M′ on *k*	142	42
P on *e*2	138	22	M′ on *l*	163	35
P on *e*3	126	50	*c*1 on *c*2	150	38
P on *k*	90	00	*c*1 on *d*1	155	10
M on *b*	133	2	*c*1 on *d*2	137	20
M on *c*1	99	30	*c*1 on *d*3	125	41
M on *c*2	115	52	*c*1 on *k*	90	00
M′ on *d*1	119	30	*c*2 on *d*4	161	20
M′ on *d*2	131	34	*i*2 on *i*2′	112	55
M′ on *e*′1	122	50			

Cleavage, parallel to P and the shorter diagonal of the prism, rather perfect; parallel to *n* and M less distinct. Fracture conchoidal. Surface, the prisms streaked in the direction of the principal axis, parallel to that line: the rest of the faces commonly rough.

Lustre resinous. Color, aurora-red, several shades, little differing from each other. Streak orange yellow... aurora-red.

Sectile. Hardness = 1·5 ... 2·0. Sp. gr. = 3·566.

Compound Varieties. Massive: composition granular, of various sizes of individuals, strongly connected. Fracture conchoidal, uneven.

1. Before the blow-pipe, upon charcoal, it burns with a blue flame, and emits fumes of sulphur and arsenic. It is soluble in nitric, muriatic and sulphuric acids.

2. *Analysis.*

	By KLAPROTH.	By LAUGIER.
Sulphur	31·00	30·43
Arsenic	69·00	69·57

3. Some of the varieties of Realgar occur along with Orpiment, in beds of clay, as at Tajowa in Hungary. It is found in small nodules along

with Fahlerz and Iron Pyrites, engaged in Dolomite, at St. Gothard in Switzerland. More generally, it is met with in metalliferous veins, particularly with ores of silver and lead, with Native Arsenic, several species of Pyrites and Heavy Spar. The chief localities are Kapnik and Nagyag in Transylvania, Felsobänya in Upper Hungary, Joachimsthal in Bohemia, Schneeberg in Saxony, Andreasberg in the Hartz, and many other places. It also occurs in Peru.

4. Like Orpiment, it is employed as a pigment.

RED ANTIMONY. Prismatic Malacone Blende.

Primary form. Right rhombic prism. M on M = 101° 19′.

Secondary form. Primary form, having the edges truncated.

Cleavage, parallel with M and the shorter diagonal, perfect; traces in other directions.

Fracture not observable. Surface more or less deeply streaked, longitudinally.

Lustre common or metallic adamantine. Color cherry-red. Streak cherry-red, or brownish-red. Translucent in thin laminæ.

Sectile. Thin laminæ are slightly flexible. Hardness = 1·0 . . . 1·5. Sp. gr. = 4·493.

Compound Varieties. Tufts of capillary crystals. Massive: composition very thin columnar, straight and divergent from common centres.

1. The variety of Red Antimony, called *Tinder-Ore*, comprises those varieties which, originally consisting of short capillary fibres interlaced with each other, appear in flakes resembling tinder.

2. Alone before the blow-pipe, it melts easily upon charcoal, by which it is absorbed, but is at last entirely volatilized. When immersed in nitric acid, it is covered with a white coating.

3. *Analysis.*

	By KLAPROTH.	By ROSE, from Braunsdorf.
Antimony	67·50	74·45
Oxygen	10·80	4·27
Sulphur	19·70	20·47

4. It is almost always accompanied by Grey Antimony, which has led to the opinion among some mineralogists, that it owes its origin to the decomposition of that species. It occurs in veins.

5. It is found at Braunsdorf near Freiberg in Saxony, at Malazka near Pösing in Hungary, and at Allemont in Dauphiny in France. The Tinder-Ore occurs at Clausthal and Andreasberg in the Hartz.

RED COPPER-ORE. Octahedral Eruthrone-Ore.

Primary form. Regular octahedron.

Secondary forms.

1. Octahedron, with edges truncated.

2. Rhombic dodecahedron.

3. Rhombic dodecahedron, with acute solid angles truncated.

4. Octahedron, with angles truncated.

5. Cube.

6. Cube, with edges truncated.

7. Cube, with edges and angles truncated.

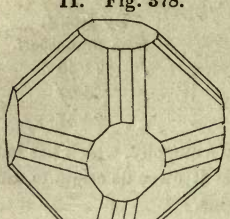
8. Cube, with edges truncated, and angles replaced by three planes, inclining to the faces of the cube, the angle of the acumination being truncated.

9. Octahedron, with the edges bevelled.

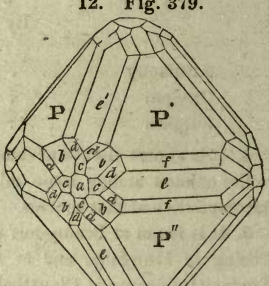
10. Octahedron, with the angles replaced by four plances resting on the primary planes.

Red Copper-Ore.

11. Fig. 378.



12. Fig. 379.



P on P	- -	109°	30′	PHILLIPS.
P on *a*	- -	125	10	"
P on *b*	- -	160	42	"
a on *b*	- -	144	38	"
e on *e*	- -	120	00	"

Cleavage, parallel with the primary planes, but much interrupted. Fracture conchoidal, uneven. Surface generally very smooth and shining, and every where the same.

Lustre adamantine, sometimes metallic adamantine, or imperfectly metallic. Color between cochineal-red, and in capillary crystals almost carmine-red. Streak several shades of brownish-red, shining. Semi-transparent . . . translucent on the edges.

Brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 8·992.

Compound Varieties. Massive: composition granular, individuals of various sizes, or even impalpable. In the latter case, fracture becomes flat conchoidal, or even, the surface of the fracture glimmering. Sometimes earthy.

1. Those varieties which consist of friable particles, and present an earthy fracture, and which are besides often mixed with oxide of iron or malachite, constitute the *Tile-Ore*, which was formerly considered as a

particular species, and divided into *earthy* and *indurated Tile-Ore*. *Red Copper-Ore* itself (the remaining varieties of the present species,) was divided into three subspecies—the *foliated*, which contains those crystallized varieties which are not capillary, together with compound cleavable ones; the *capillary*, which comprehends very thin filiform crystals, reticulated, or in velvety groups; and the *compact*, which refers to impalpable compositions.

2. In the reducing flame of the blow-pipe, it is reduced upon charcoal into a globule of copper. It is soluble with effervescence in nitric acid, but without effervescence in muriatic acid.

3. *Analysis.*

	By Klaproth.	By Chenevix.
Copper . . .	91·00	88·50
Oxygen . . .	9·00	11·50

4. It is found in beds and veins in several rocks, accompanied by various other ores of copper and iron, and by Quartz.

5. Nearly one hundred modifications of form have been observed in the crystals of Cornwall, at which place the species occurs in tin and copper veins. Handsome crystallizations also occur in the Bannat of Temeswar, in the vicinity of Moldawa; near Catharineburgh in Siberia, and at Chessy near Lyons in France. Other localities of this species are found in Prussia and Saxony, but particularly in Chili and Peru. The principal deposits of the capillary variety, are Cornwall, and Rheinbreitbach on the Rhine. Tile-Ore is found among other varieties in the Bannat, and at Camsdorf and Saalfeld in Thuringia. This species has been obtained massive, along with Chrysocolla and Native Copper, in the U. States, at Schuyler's mine in New Jersey.

Red Copper-Ore is frequently produced in the slags formed in the last process of melting copper. Copper vessels, long exposed to the action of the weather, are, to a great extent, converted into a tissue of crystals, of the present species, while the outside is covered with chloride of copper.

6. It is valuable as an ore of copper.

RED LEAD-ORE. Hemi-prismatic Lead-Baryte.

Primary form. Oblique rhombic prism. M on M′ = 93° 30′.

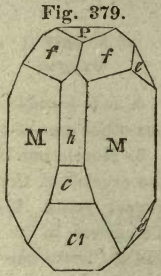
Red Lead-Ore.

Secondary forms. 1. The primary, having the obtuse terminal edges replaced by single planes, and then so far extended as to obliterate the terminal plane; the lateral edges of the prisms being replaced by tangent planes.

2. The same as the above, having in addition the acute terminal edges replaced, so as to impart four-sided summits to the crystals.

3. The same as 2, with the exception of having the oblique edges of the prism replaced, instead of the lateral, as in

Fig. 379.



P on M -	99	10′	PHILLIPS.
P on *e* -	119	10	"
P on *f* -	133	00	"
P on *h* -	102	5	"
M or M on *c*1	133	10	"
M or M on *f*	146	25	"
M or M on *h*	136	35	"
e on *f* -	140	3	"
f on *f* -	118	58	"

Cleavage, parallel to the primary, tolerably distinct: less so to the bases, than to the sides of the prism. Fracture small conchoidal, uneven. Surface, M streaked longitudinally. The faces mostly smooth and shining.

Lustre adamantine. Color various shades of hyacinth-red. Streak orange-yellow. Translucent.

Sectile. Hardness = 2·5 ... 3·0. Sp. gr. = 6·004.

Compound Varieties. Massive: composition imperfectly columnar, or granular.

1. Before the blow-pipe, it becomes black and decrepitates, if quickly heated; it may be melted, however, into a shining slag, containing globules of metallic lead. It colors glass of borax green, is soluble without effervescence in nitric acid, and affords a yellow solution in that acid.

2. *Analysis.*

	By Pfaff.	By Berzelius.
Oxide of lead	68·00	68·14
Chromic acid	32·00	31·86

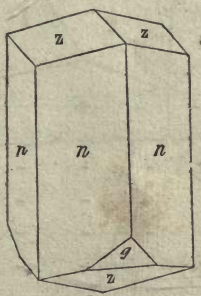
3. Red Lead-Ore has been found in Siberia, in the neighborhood of Beresof; where it occurs in narrow veins, traversing a rock, the true nature of which is not ascertained. It is accompanied by cubical crystals of Iron Pyrites, generally in a state of partial decomposition; also by Galena, several salts of Lead, and sometimes by Native Gold. In Brazil, it is met with in sandstone, probably under similar circumstances.

RED SILVER. Red Malacone-Blende.

Primary form. Rhomboid. P on P = 108° 39′ 39″.

Secondary forms.

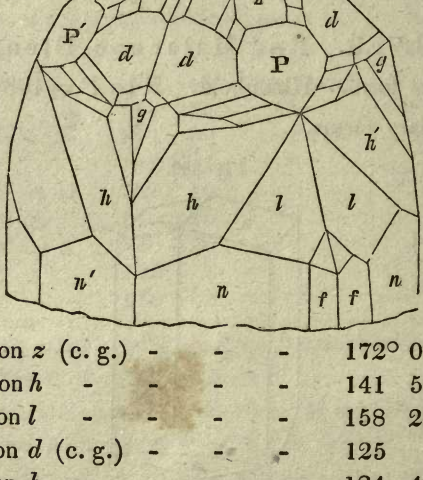
Fig. 380.



Similar to those of Proustite, (q. v.) and several others resembling the secondary forms of Calcareous Spar. Annexed is a crystal, measured by Phillips, which combines the principal modifications, under which Red Silver is seen. It is obvious from an inspection of the figure, that the planes *z* tend by their extension to the production of an obtuse rhomboid; the planes *g*, to acute rhomboids; the planes *d*, and the four planes without letters, situated

directly above them, to obtuse scalene dodecahedrons; the planes *h*, and the three sets of planes around *g*, *l* and the three elongated planes between *h* and *d*, all tend to acute scalene dodecahedrons; *f* and *n* lead to regular six-sided prisms.

Fig. 381.



P on *z* (c. g.)	-	-	-	172°	00′
P on *h*	-	-	-	-	141	50
P on *l*	-	-	-	-	158	22
d on *d* (c. g.)	-	-	-	125	
h on *h*	-	-	-	-	134	40
n on *n*	-	-	-	-	120	

Cleavage parallel with P, pretty distinct in some varieties. Fracture conchoidal. Surface, *f* and *n* striated vertically; P, *z*, and *g*, and most of the adjoining faces streaked parallel to their common edges of combination.

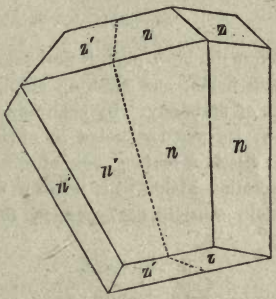
Lustre metallic-adamantine. Color, iron-black, lead-grey, sometimes approaching cochineal-red. Streak, cochineal-red, in shades corresponding to the color. Translucent to opake.

Red Silver.

Sectile. Hardness $=2\cdot5 \ldots 3\cdot0$. Sp. gr. $=5\cdot787 \ldots 5\cdot844$. BREITHAUPT.

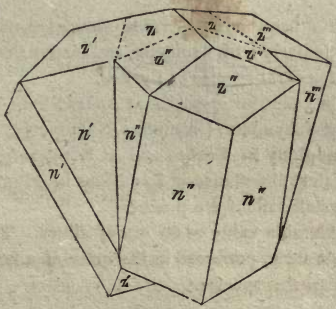
Compound Varieties. 1. Twin-crystals. Face of composition perpendicular, axis of revolution parallel, to an edge of z.

Fig. 382.



This kind of regular composition is frequently repeated, contiguous to all the terminal edges of z, as in

Fig. 383.



2. Face of composition parallel, axis of revolution perpendicular to g.

Red Silver.

3. Face of composition parallel to *n*, axis of revolution perpendicular to it. The individuals are sometimes continued beyond the face of composition. Massive: composition granular, of various sizes of individuals, strongly connected. If the composition becomes impalpable, fracture is uneven, even, or flat conchoidal. Plates, superficial coatings.

1. When heated before the blow-pipe, it first decrepitates, then melts, burning with a bluish flame, and emitting sulphurous acid together with the white smoke of antimony. By continuing the heat, a globule of silver is obtained. Its powder heated in nitric acid, turns black, emits red fumes, and dissolves leaving behind some sulphur and oxide of antimony. The solution yields with water a white precipitate, on the separation of which, muriatic acid occasions the deposition of chloride of silver.

2. *Analysis.*

By Bonsdorff.

A var. from Andreasberg.

Sulphur	16·609
Antimony	22·846
Silver	58·949
Earthy matter	0·299

3. It has hitherto been found in veins associated with various other ores of silver, particularly with Proustite, and Native Silver, also with Galena, Blende, and several species of Pyrites.

4. It is found in beautiful crystals, at Andreasberg in the Hartz, and is also met with at Schemnitz, Cremnitz, Nagybanya, &c. in Hungary, in Alsace and Dauphiny in France and at Kongsberg in Norway. It occurs in the greatest abundance at Zacatécas in Mexico, from whence very splendid crystallizations are procured.

5. It is of considerable value as an ore of silver. The mine of Veta-Negra, near Sombrerète, produced in the space of a few months 700,000 marcs of silver from this species.

Red Vitriol. (See *Cobalt-Vitriol.*)

RED ZINC-ORE. Hemi-prismatic Eruthrone-Ore.

Primary form. Right rhombic prism?

Cleavage, in one direction perfect, in three others less so, and apparently different in each. Two angles are afforded by the reflective goniometer, one of 125°, the other of 90°. Fracture conchoidal.

Lustre adamantine. Color red, inclining to yellow. Streak, orange-yellow. Translucent on the edges.

Brittle. Hardness =4·0 ... 4·5. Sp. gr. =5·432 ... 5·523.

Compound Varieties. Massive; composition granular, individuals strongly connected.

1. On exposure to the air, it suffers partial decomposition at the surface, becoming invested with a white coating, which is carbonate of zinc. Alone before the blow-pipe, it is infusible, but yields a yellow transparent glass with borax. It is soluble without effervescence, in nitric acid.

2. *Analysis.*

	By Bruce.	By Berthier.
Oxide of zinc . . .	92·00 . . .	88·00
Oxide of iron and manganese	8·00 . . .	12·00

3. It occurs massive, mixed with Calcareous Spar and Franklinite, at Franklin and Stirling, (N. J.) It is set free in several metallurgic processes, and occurs crystallized in six-sided prisms of a yellow color, in the foundaries of Konigshütte in Silesia.

Retinasphalt. (See *Retinite.*)

Retinite.

Roundish, and blunt-edged masses. Fracture conchoidal.

Lustre resinous. Color green, yellow, red, brown, sometimes in striped delineations. Semi-transparent to opake.

Hardness =1·5 ... 2·0, of the variety from Halle. Sp. gr. = 1·135.

Red Zinc-Ore—Rhomb Spar.

1. Retinite, if rubbed in an isolated state, acquires negative electricity. In the flame of a candle, it melts and takes fire with a particular odor. It is partly soluble in alcohol, leaving behind an unctuous residue.

2. *Analysis.*

	By Hatchett.	By Bucholz.
Vegetable resin	55·00	91·00
Asphalt or bitumen	42·00	9·00
Earthy matter	3·00	0·00

3. It has been found in the beds of earthy brown coal near Halle on the Saale; at Bovey in Devonshire, also in Upper Austria, Moravia, &c. The variety from Halle very much resembles a vegetable resin. The purer specimens frequently consist of alternating layers more or less transparent, corresponding to the external shape, and commonly including a cavity. Its Sp. gr. =1·079.

Reussin. (See *Bloedite.*)

Rhaetizite. (See *Kyanite.*)

Rhodonite. (See *Manganese Spar.*)

RHOMB SPAR. Brachytypous Lime-Haloide. Mohs.

Primary form. Rhomboid. P on P =107° 22′.

Cleavage, highly perfect parallel with the primary form. Fracture, often conchoidal, at right angles to the axis. Surface, even, or rather rough.

Lustre vitreous, sometimes inclining to pearly upon faces of cleavage. Color white or grey, generally inclining to yellow; also yellow and brown. Streak greyish-white. Transparent... translucent.

Brittle. Hardness =4·0 { 3·001, clove brown } variety.
...4·5. Specific gravity = { 3·112, pale yellow }

Compound Varieties. Massive: composition granular, individuals strongly coherent; face of composition uneven and rough.

1. Before the blow-pipe, and also from long exposure to the weather, it turns brownish-black.

2. *Analysis.*

By Brooke.

Carbonate of iron and carbonate of magnesia, in the ratio of 1·315 of the former to 8·685 of the latter.

3. The varieties of the present species have often been found accompanying those of Dolomite; it also occurs in chloritic steatite.

4. It occurs at various places in Salzburg, Tyrol and Switzerland, also in Unst, one of the Shetland Isles. In the U. S. at Marlborough, (Vt.) in steatite; at Middlefield, (Mass.) and generally, in most of the soapstone quarries of New England.

Appendix to Rhomb Spar.

i. *Hystatic Carbon-Spar.* Breithaupt.

P on P = 107° 28′ 20″.

Cleavage, very perfect parallel with the primary form.

Hardness = 5·5 . . . 5·75 (scale of Breithaupt.) Sp. gr. = 3·040 . . . 3·089.

It is not believed to be a very rare species. Localities quoted, are the Hartz, Erbendorf in the Fichtelgebirge.

RIONITE. Selenious Malacone-Blende.

Primary form. Unknown. Massive: composition granular.

Color cochineal-red, to lead-grey. Streak of the lead-grey variety, blackish.

Sp. gr. = 5·5 . . . 5·6.

1. Under the blow-pipe, it burns with a beautiful, violet-colored flame, attended by much smoke, and the peculiar odor of selenium.

2. *Analysis.*

By Del Rio.

The grey colored variety.

Selenium	49·00
Zinc	24·00
Mercury	19·00
Sulphur	1·50

which, with the addition of 6 p. c. of lime mechanically intermingled,

will amount to 99·5. It is, therefore, a bi-seleniuret of zinc united to a proto-sulphuret of mercury; the latter giving the grey color to the mineral. The red mineral is regarded as a bi-seleniuret of zinc, the mercury being in the state of a bi-sulphuret, which communicates the red color.

3. It is found at Calebras, near the mining district of El Doctor, in limestone, overlying the red sandstone, and is accompanied by Native Quicksilver.

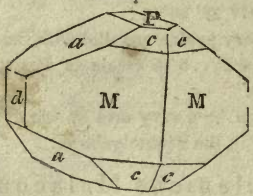
4. A fuller examination of the red and grey varieties, may show that they form distinct species.

Roselite.

Primary form. Right rhombic prism. M on M = 132° 48′.

Secondary form.

Fig. 384.



a on *a* over *d* = 45° 0′

Cleavage perfect parallel to *d*. Surface M rough and hollowed out in the middle.

Lustre vitreous. Color deep rose-red. Streak white. Translucent.

Hardness = 3·0.

1. Before the blow-pipe, it gives off water and becomes black. It imparts a blue color to borax and salt of phosphorus; and is entirely soluble in muriatic acid. According to Children, it contains water, oxide of cobalt, lime, arsenic acid and magnesia.

2. It occurs at Schneeberg in Saxony, disposed on Quartz, and was formerly considered as a variety of Cobalt-Bloom.

3. It is nearly related to Pharmacolite.

Rubellan.

In six-sided prisms, whose angles are not known.

Cleavage perfect in one direction.

Rutile.

Color reddish-brown.

Hardness rather below 3.0. Sp. gr. =2·7.

1. In the flame of a candle, it exfoliates.

2. *Analysis.*

By KLAPROTH.

Silica	45·00
Oxide of iron	20·00
Alumina	10·00
Magnesia	10·00
Potash and Soda	10·00
Volatile matter	5·00

3. It is found with Mica and Pyroxene, at Schima in the Mittelgebirge, in Bohemia.

4. It appears to be a Mica which has become altered by heat.

RUBELLITE. (See *Tourmaline.*)

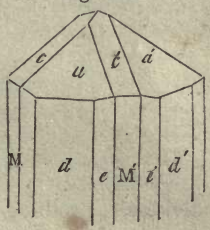
RUBINGLIMMER. (See *Limonite.*)

RUTILE. Peritomous Eruthrone-Ore.

Primary form. Right square prism.

Secondary form.

Fig. 385.



M on *d*	135° 5′	PHILLIPS.
M on *e*	161 40	"
M on *c*	122 45	"
a on *a*	123 15	"
a on *c*	151 42	"
a on *d*	123 15	"
e on *d*	153 33	"
a on *a* over summit	90 00	"
c on *c* " "	109 47	"

Rutile.

Cleavage parallel with M perfect, with *d* interrupted. Fracture conchoidal, uneven. Surface, *a* and *c*, either smooth or rough, but both of the same quality; *d*, *e* and M vertically streaked.

Lustre metallic-adamantine. Color reddish brown, passing into red, sometimes yellowish. Streak very pale-brown. Translucent . . . opake, sometimes in a strong light, transparent.

Hardness = 6·0 . . . 6·5. Sp. gr. = 4·249.

Compound Varieties. Twin-crystals very frequent, axis of revolution perpendicular, face of composition parallel to face *a*. The composition produces geniculated groups, and is often repeated in several geniculations, as in fig. 387.

Fig. 386.

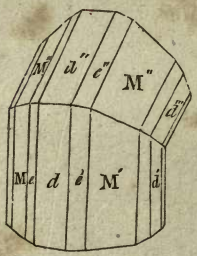
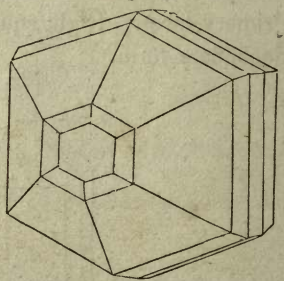


Fig. 387.



Thin and long individuals, produce after this law, a reticulated composition. Massive, composition granular, the individuals being of various sizes and strongly connected.

1. Alone before the blow-pipe, it is infusible, but gives with borax in the reducing flame a yellow glass, which assumes an amethyst-color, when farther reduced.

2. *Analysis.*

If pure, it is entirely composed of oxide of titanium, which according to Rose, consists of metal 66·05, and of oxygen 33·95.

3. It occurs, generally, in imbedded crystals, either in masses of Quartz engaged in gneiss or mica-slate, or in Feldspar in chlorite-slate. It is sometimes found massive in metalliferous veins, and is often enclosed in crystals of Quartz: besides, it occurs in the shape of pebbles in some gold stream-works.

4. Imbedded crystals in Quartz have been found at Rosenau in Hungary, Teinach on the Bacher in Stiria, and at various places along the chain of the Alps; also at Crianlarich in Perthshire and other places in Scotland. Very perfect crystals occur in the Saualpe, and massive varieties at Arendal in Norway. Switzerland and Savoy afford several localities. Pebbles have been found at Ohlapian in Transylvania which on account of their dark color, have been called Nigrine. At St. Yrieix in France, and in the province of Guadalaxara in Spain, the well known twin-crystals occur, often of very considerable dimensions. Finely crystallized individuals are brought from St. Gothard, and beautiful capillary crystals engaged in transparent Quartz, from Brazil.

The locality affording Rutile in the greatest quantity in the United States, is a very extensive ledge of chlorite-slate at Windsor, (Mass.) The crystals of Rutile are here thickly disseminated through narrow veins of Feldspar traversing this rock, and also occur in seams in the rock itself. Large compound crystals of a dark color, occur at Monroe and Huntington, (Conn.) rarely in the form of fig. 387. The mica-slate of Hampshire, Berkshire and Franklin counties, (Mass.) affords this species, but no where, in any considerable quantity. It is found in small brilliant crystals in white limestone with Spinel, Serpentine, Talc, Mica, &c. at Amity, (N. Y.) and with blue Corundum, Tourmaline and Spinel in the same rock at Newton, (N. J.) also in loose crystals in North Carolina and Virginia. It is on the whole, one of the most widely diffused of the scarce metals, existing in small quantity at numerous localities, but no where in the United States, excepting Windsor, in abundance.

SAHLITE. (See *Pyroxene.*)

SAL-AMMONIAC. Octahedral Ammoniac-Salt. MOHS.

Primary form. Regular octahedron.

Secondary forms. Cube. Trapezohedron.

Sal-Ammoniac.

Cleavage, parallel with the primary faces. Fracture conchoidal. Surface smooth.

Lustre vitreous. Color generally white, often inclining to yellow or grey. Sometimes it is stained green, yellow, or black. Transparent . . . translucent.

Very sectile. Hardness = 1·5 . . . 2·0. Sp. gr. = 1·528. Taste acute and pungent.

Compound Varieties. Stalactitic, botryoidal, globular, reniform shapes, also in crusts; composition columnar. Massive, composition impalpable. Fracture conchoidal. Sometimes in a state of mealy efflorescence.

1. It is perfectly volatile at a high temperature, dissolves readily in water, but does not attract water from the atmosphere. It emits a pungent smell of ammonia, if brought into contact with moistened quicklime.

2. *Analysis.*

By KLAPROTH.
From Mt. Vesuvius.

Muriate of ammonia	99·5
Muriate of soda	0·5

3. It occurs in fissures in the immediate vicinity of active volcanoes; and is a product of sublimation. It is also found near burning coal seams.

4. The best known localities, are Mount Etna and Vesuvius, the Solfataras, the Lipari islands, England, (particularly the neighborhood of New Castle) Scotland, Iceland, the vicinity of Liège, the Bucharian Tartary, &c.

This salt though much employed in the arts of dyeing, and in medicine, is of very little importance, as found in nature, on account of its scarcity.

SAPHIRINE.

Massive; cleavable.

Lustre vitreous. Color sapphire-blue, with shades of green and grey. Translucent. Streak white.

Hardness, scratches Quartz. Sp. gr. = 3·42.

Sassolin.

1. Before the blow-pipe, alone and with borax, it is infusible.

2. *Analysis.*

By STROMEYER.

Alumina	63·1
Silica	14·5
Magnesia	16·8
Lime	0·3
Protoxide of iron	3·9
Protoxide of manganese	0·5
Water	0·5

3. It occurs at Fiskanaes in Greenland, in a mica-slate rock.

SAPPARE. (See *Kyanite.*)

SAPPARITE.

Crystals, right rectangular prisms. Cleavage perfect, parallel with their lateral planes. Cross-fracture, uneven, to splintery. Lustre, chatoyant. Color blue, very intense. Transparent. Hardness, not sufficient to scratch glass.

Powder of a clear greyish-white color.

1. It comes from Pegu or Ceylon, and is found engaged in a druse of Spinel.

SARCOLITE. (See *Analcime.*)

SASSOLIN. Prismatic Boracic-Acid. MOHS.

Loose scaly particles, crystalline grains, (probably six-sided tables) sometimes aggregated in the form of crusts.

Lustre pearly. Color greyish and yellowish-white. Streak white. Feebly translucent.

Sp. gr. =1·480. Taste acidulous, afterwards bitter and cooling, lastly sweetish.

1. It is fusible in the flame of a candle, yielding a glassy globule, which acquires resinous electricity by friction, even without being isolated.

2. *Analysis.*

By BERZELIUS.

Borax	25·83
Oxygen	74·17

3. It occurs in a state of perfect purity, or only mixed with a little Sulphur, at the island of Volcano one of the Lipari group. It is also deposited from hot springs near Sasso, and from the *lagoni* of Tuscany.

4. It is extensively employed in the manufacture of borax.

SAUSSURITE. Dusclaone Petaline-Spar.

Primary form, unknown.

Cleavage, affords two faces meeting at angles of 124° nearly, pretty distinct. Traces parallel to the short diagonal of that prism. Fracture uneven, splintery. Massive: composition granular . . . impalpable, strongly coherent.

Lustre pearly, inclining to vitreous upon the faces of cleavage; resinous in compound varieties, particularly when cut and polished. Color white, passing into mountain green, greenish-grey and ash-grey. Streak white.

Brittle, very difficultly frangible. Hardness = 5·5. Sp. gr. = 3·256 of a granular variety from Piedmont, 3·342 of a compact variety from the Pays de Vaud.

1. Before the blow-pipe, it melts with difficulty into a white glass.

2. *Analysis.*

	By Saussure.		By Klaproth.
Silica	49·00		44·00
Alumina	24·00		30·00
Lime	10·00		4·00
Magnesia	3·75	Potash	0·25
Oxide of iron	6·50		12·50
Oxide of manganese	0·00		0·05
Soda	5·50		6·00
Loss	0·75		3·20

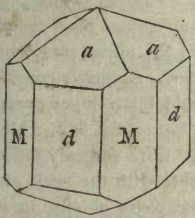
3. It is found in primitive mountains, and constitutes with Hornblende and Augite, the rocks called gabbro and euphotide. It occurs ni large masses upon Monte Rosa, and in its neighborhood; in Corsica; in the Bacher mountain in Lower Stiria, in Baryeuth, &c. In the United States at Canaan, (Conn.), it forms a mountain of some miles in extent.

SCAPOLITE. Pyramidal Petaline-Spar.

Primary form. Right square prism.

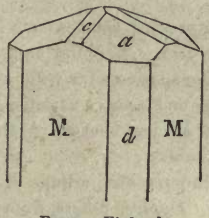
Secondary forms.

Fig. 388.



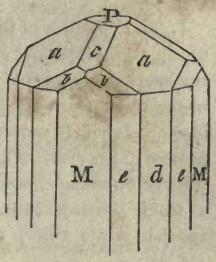
Governeur, St. Lawrence co., (N. Y.)

Fig. 389.



Pargas, Finland.

Fig. 390.



Vesuvius.

Fig. 388. d on $a = 122° 20'$. M on $d = 135°$. M on $a = 112° 30'$.—Fig. 390. a on $b = 151° 31'$. M on $b = 140° 18'$. a on $a = 136° 22'$. M on $e = 153° 24'$. d on $e = 161° 35'$.

Cleavage, parallel with M and d distinct, but interrupted; traces of P, generally a small conchoidal fracture in this last direction. Fracture imperfectly conchoidal, uneven. Surface of the prisms longitudinally streaked, but generally of nearly the same physical quality.

Lustre vitreous, inclining to resinous upon the cleavage and fracture, parallel with the bases; inclining to pearly upon M and d. Color various shades of white, grey, blue, green and red. Streak greyish white. Transparent... translucent on the edges.

Brittle. Hardness = 5·0 ... 5·5. Sp. gr. = 2·612, Meionite; = 2·726, white crystallized Scapolite from Finland.

Scapolite.

Compound Varieties. Massive: composition granular, of various sizes of individuals, sometimes elongated in one direction, or wedge shaped, and passing into columnar, or fibrous; generally strongly coherent.

1. The varieties of the present species have been treated of as constituting several distinct species. *Meionite* contains the purest and most transparent varieties of the species, of a white color. *Scapolite* consists of the translucent crystals and massive varieties, which are tinged green, black and red. *Wernerite* occurs in crystals of the form of fig. 389, which possess a greyish, or greenish grey, color. *Nuttallite* scarcely differs from Wernerite except in possessing a tinge of blue with the grey, and a feeble chatoyément. *Dypire* differs from Scapolite chiefly in its reddish white color, and thin columnar composition in massive varieties.

2. In a strong heat of the blow-pipe, Scapolite melts into a vesicular glass, and intumesces considerably; it then assumes the appearance of ice, and does not melt any longer. It is dissolved by borax with effervescence, melting into a clear globule.

3. *Analysis.*

Analysts.	Varieties.	Alumina.	Silica.	Potash & Soda.	Lime.	Protox. of iron.	Water.
John.	Wernerite.	30·000	50·250	2·000 potash	10·450	3·000	2·85
Laugier.	Scapolite.	33·000	45·000	2·000	17·600	1·000	0.00
Nordenskiold.	do. fr. Pargas.	35·430	43·830	0·000	18·960	0·000	1·03
Stromeyer.	Meionite.	32·726	40·530	1·812	24·245	0·182	0·00
Gmelin.	Meionite.	30·600	40·800	2·400	22·100	1·000	0·00
Thomson.	Nuttallite.	37·808	25·104	7·305 potash	18·336	1·500	0·00

4. Meionite is met with among the minerals ejected by volcanoes. The varieties of Scapolite occur in primitive rocks, as in the beds of Magnetic Iron in Sweden and Norway, and are generally accompanied by Pyroxene and Hornblende; also in beds of white limestone, associated with the above minerals, and in addition with Sphene and Petalite.

5. Scapolite is found at Arendal in Norway and in Wermeland in Sweden; also in large and beautiful crystals in the parish of Pargas, Finland, at Akudlek in Greenland, and some varieties near Chursdorf in Saxony. Dypire is found at Mauléon in the Western Pyrenees. Meionite occurs at Mt. Vesuvius.

Numerous localities of Scapolite are found in the United States. Beautiful crystals of the form of fig. 388, are found at Governeur, (N. Y) disseminated through a coarsely granular Calcareous Spar. Large crystals of a white variety rarely terminated with regularity, occur penetrating Quartz, which itself forms veins in white limestone at Bolton and Boxborough, (Mass.) Nuttallite is found also at Bolton in implanted crystals, rarely surmounted by four-sided pyramids. A purple variety exists at the same place, forming considerable masses, made up of large columnar individuals. Compact varieties occur at Boxborough and Westfield, (Mass.) A fibrous one is found at Monroe, (Connecticut.) Crystallized specimens are afforded by the white limestone of Amity, (N. Y.)

SCARBROITE.

Massive: composition impalpable. Fracture conchoidal. Dull. Color white.

Very fragile. Sp. gr. =1·485.

1. It absorbs water without becoming more transparent.

2. *Analysis.*

Silica	. .	10·50	. . .	7·90
Alumina	. .	42·50	. . .	42·75
Oxide of iron	. .	0·25	. . .	0·80
Water	. .	46·75	. . .	48·55

3. It is found in little veins in greywacke in the great hill of Scarborough, England.

4. It is probably a mere mechanical aggregate, similar to clays in general.

SCHAALSTEIN. (See *Tabular Spar.*)

SCHEELETINE. Tungstic Lead-Baryte.

Primary form. Octahedron with a square base. P on P over the base = 131° 29′ 33″.

Secondary form, the primary, having the edges of the base and the pyramidal edges truncated, together with the

replacement of the angles at the summit, by four planes, resting on the primary planes.

Cleavage, parallel with the primary faces, indistinct.

Lustre resinous. Color green, grey, brown and red. Streak white.

Hardness $=2{\cdot}75 \ldots 3{\cdot}0$. Sp. gr. $=7{\cdot}904 \ldots 8{\cdot}088$.

1. It is fusible before the blow-pipe, yielding oxide of lead upon the charcoal. With soda, it affords globules of metallic lead.

2. *Analysis.*

Tungstic acid	52·00
Oxide of lead	48·00

3. It is a very rare substance; and is found in minute crystals, in the tin mines of Zinwald, Bohemia.

SCHEEVERITE.

In crystalline grains.

Lustre pearly, and feebly shining. Color whitish.

Friable. Rather heavier than water.

1. By heating, it emits a feeble aromatic empyreuma. It melts, very readily, into a colorless liquid. The melted mineral, on cooling, crystallizes into four-sided, acicular crystals. It burns with flame, attended with feeble odor, and without leaving behind any residue.

2. *Analysis.*

Carbon	73·00
Hydrogen	24·00

3. It is found in loosely aggregated grains, forming nests in a bed of brown coal, at St. Galen in Switzerland.

SCHILLER-SPAR. Diatomous Schiller-Spar. MOHS.

Primary form. Doubly oblique prism?

Cleavage in two directions, one of them being highly perfect and easily obtained, while the other appears only in slight traces. Inclination between 135° and 145°. Fracture uneven, splintery.

Lustre, metallic pearly, eminently so upon the perfect faces of cleavage; indistinctly vitreous upon the other faces. Color olive-green and blackish green, inclining to pinch-beck-brown upon the perfect faces of cleavage. Streak greyish white, inclining a little to yellow. Translucent on the edges.

Rather sectile. Hardness = 3·5 . . . 4·0. Sp. gr. = 2·692.

Compound Varieties. Massive: composition granular, of various sizes of individuals. The individuals are often intermingled with Serpentine.

1. Exposed to a high degree of heat, it hardens into a porcelainous mass.

2. *Analysis.*

	By Heyer.	By Vauquelin.	By Drappier.
Silica	52·00	62·00	41·00
Magnesia	6·00	10·00	29·00
Alumina	23·33	13 00	3·00
Lime	7·00	0·00	1·00
Oxide of iron	17·50	13·00 and manganese.	14·00
Water	0·00	0 00	10·00

3. The varieties of Schiller-Spar occur imbedded in simple and compound crystalline masses in serpentine, with which they are mixed. The only locality in Europe, which can be quoted with certainty, is the Baste in the forest of Harzgeburg in the Hartz. It is found of a blackish color, with Serpentine and Kerolite, at Blandford, (Mass.)

Schorl. (See *Tourmaline.*)

Scolezite. (See *Mesotype.*)

SELENCUPRITE. Selencupreous Polypoione-Glance.

Massive: composition impalpable.

Lustre metallic. Color silver-white. Streak shining. Ductile?

1. Fusible before the blow-pipe into a grey globule, which is slightly malleable. It is decomposed by nitric acid, and the solution deposits metallic copper on a piece of clean iron.

2. *Analysis.*
By Berzelius.

Selenium	40·00
Copper	64·00

3. It occurs forming black coatings upon Calcareous Spar, or in minute seams traversing this substance, at the copper-mine of Skrickerum in Smoland.

Seleniuret of Copper. (See *Selencuprite.*)

Seleniuret of Lead. (See *Clausthalite.*)

Seleniuret of Palladium. (See *Selenpalladite.*)

Seleniuret of Silver and Copper. (See *Eukairite.*)

Seleniuret of Sulphur. (See *Sulpho-selenite.*)

Seleniuret of Zinc and Mercury. (See *Rionite.*)

Selenpalladite.

Primary form. Regular hexagonal prism.
Cleavage, parallel with the base, perfect.
Lustre metallic. Color white to grey. Opake.
Brittle.

1. Heated in a glass tube, it gives a red ring of selenium. It is fusible into a brittle metallic globule, and dissolves with borax into a colorless glass. The roasted ore affords in nitro-muriatic acid a brown solution, from which some chloride of silver, and crystalline chloride of lead, is precipitated. The addition of cyanide of mercury, colors the solution, and throws down cyanide of palladium. According to Zinken, it consists of seleniuret of palladium, seleniuret of silver, and seleniuret of lead.

2. It is found with Native Gold and Clausthalite, at Zilkerode in the Hartz. It is likewise said to occur in the Russian platina-mines.

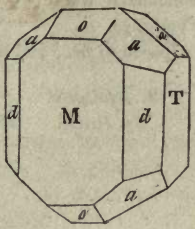
SERPENTINE. Prismatic Atelene-Picrosmine.

Primary form. Right rectangular prism.

Serpentine.

Secondary form.

Fig. 391.



o on *o*	-	-	-	-	128°	31′
d on *d*	-	-	-	-	97	33
a on *a′*	-	-	-	-	139	34
a on *a*	-	-	-	-	105	26
a on *d*	-	-	-	-	134	13

Cleavage. Traces of, parallel with M and *d*, apparent only in a strong light. Fracture flat conchoidal, splintery, uneven. Surface almost dull, very little glistening, but rather even.

Lustre resinous, indistinct, low degrees of intensity. Color dark blackish green and leek-green, seldom lighter shades of oil-green and siskin-green colors, none of them being bright: they pass into yellowish-grey. Streak white, acquires some lustre. Translucent . . . opake.

Sectile. Hardness=3·0. Sp. gr.=2·507, of a greenish black crystallized variety; =2·56, of an oil-green, translucent one.

Compound Varieties. Massive: composition granular, impalpable. Varieties of this kind present also, red, brown, black, yellow, and grey colors, in different veined, spotted and other delineations. The purer varieties sometimes possess an indistinctly slaty structure.

Serpentine.

1. Serpentine is divided into two subspecies, the *common* and *precious;* the latter embracing those varieties which possess handsome colors, and a tendency to conchoidal fracture; the former includes the duller colors and the slaty varieties.

2. It hardens on being exposed to fire, and melts only with great difficulty on the edges.

3. *Analysis.*

By JOHN.

Silica	42·50
Magnesia	38·63
Alumina	1·00
Lime	0·25
Oxide of iron	1·50
Oxide of manganese	0·62
Oxide of chrome	0·25
Water	15·20

4. Serpentine forms mountain masses and beds in primitive rocks, and frequently contains crystals, grains, or compound nodules of various other species. Precious Serpentine, in particular, is often mixed with white limestone.

5. The different varieties of Serpentine are met with in Saxony, Silesia, Austria, Hungary, Stiria, Italy, Corsica, Sweden, England, Scotland, and other foreign countries.

Crystallized varieties, of a blackish green color, sometimes of considerable dimensions, occur at Amity, (N. Y.) disseminated through limestone, along with black Spinel and Ilmenite; also at Byram, (N. J.) in the same rock with red Spinel. At the last place, the color of the Serpentine is oil-green. Serpentine, of a handsome green color, and conchoidal fracture, is found at Newburyport, (Mass.) and at Newport, (R. I.); of a very light green color, at Phillipstown, in the Highlands of New York. Extensive formations of Serpentine exist in the neighborhood of New-Fane, (Vt.) and of Middlefield, (Mass.)

SIDERITE. (See *Quartz.*)

SIDEROSCHISOLITE. (See *Limonite.*)

SILICATE OF IRON.

SILICEOUS OXIDE OF MANGANESE. (See *Manganese Spar.*)

SILICO-CALCAREOUS OXIDE OF TITANIUM. (See *Sphene.*)

SILLIMANITE. (See *Bucholzite.*)

SILVER-BISMUTH.

In acicular and capillary crystals. Massive; composition impalpable. Fracture uneven.

Lustre metallic. Color, light lead-grey.

1. Before the blow-pipe it melts with ease, and covers the charcoal with oxide of lead and bismuth, leaving a globule of silver behind.

2. *Analysis.*

By KLAPROTH.

Lead	33·00
Bismuth	27·00
Silver	15·00
Iron	4·30
Copper	0·90
Sulphur	16·30

3. It occurs at Schlapbach in Baden.

SILVER-BLACK.

Massive; composition impalpable, in crusts, pulverulent.

Color bluish-black, sometimes blackish lead-grey.

1. It melts easily before the blow-pipe into a slaggy mass, leaving a metallic button on farther heat.

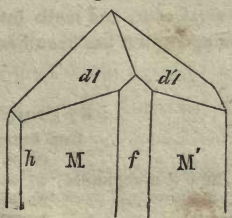
2. It is found in the silver mines of Saxony, Hungary, in Siberia, and in South America.

SKORODITE. Prismatic Malachite-Haloide. PARTSCH.

Primary form. Right rhombic prism. M on M = 120′.

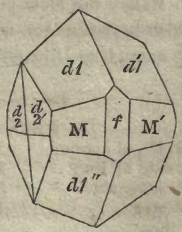
Secondary forms.

Fig. 392.



Cornwall.

Fig. 393.

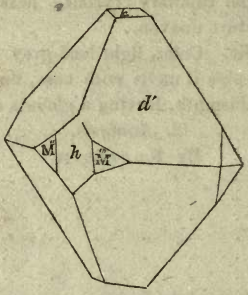


Saxony.

Skorodite.

M on $d1$	- 141° 26′	M on f	- 103° 5′
$d1$ on $d1'$	- 103 00		

Fig. 394.



Carinthia.

Cleavage, imperfect parallel to M and *f*. Fracture uneven. Surface, *d* uneven and irregularly streaked parallel to its own edges. M and *f* streaked vertically. The rest of the faces commonly very smooth and even.

Lustre vitreous, inclining to adamantine on the surface, and to resinous in the interior. Color, principally leek-green, which passes almost into white; also bluish-white, olive-green and liver-brown. Streak white. Semi-transparent . . . translucent on the edges.

Rather brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 3·162.

1. Before the blow-pipe, it emits an arsenical odor, and melts into a reddish-brown scoria, which acts upon the magnet, if it has been heated long enough to drive off all the arsenic.

2. *Analysis.*

	By Chenevix. from Cornwall.		By Ficinus. from Saxony.
Oxide of copper	22 5		00·00
Oxide of iron	27·5	with magnesia, lime & manganese.	47·80
Arsenic acid	33·5		31·40
Water	12·0		18·00
Silica	3 0		0 00
Sulphuric acid	0·0		1·54

3. It occurs in the primitive mountains of Schwarzenberg in Saxony, with Arsenical Pyrites; at Löling near Hüttenberg in Carinthia, with Leucopyrite. Beautiful specimens have been brought from Brazil.* It occurs also in several of the Cornish mines, where it has commonly been called Martial Arseniate of Copper.

SMALTINE. Octahedral Eruthleucone-Pyrites.

Primary form. Regular octahedron.

Secondary forms.

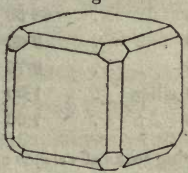
1.
Primary, with the angles truncated.
Dobschau, Saxony.

2.
Cube.
Schladming, Stiria.

3.
Cube, with edges truncated.
Schneeberg, Saxony.

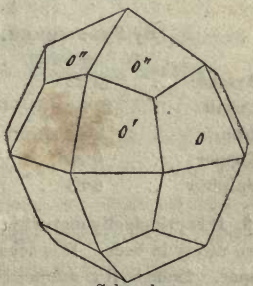
4.
Rhombic dodecahedron.

5. Fig. 395.



Schneeberg.

6. Fig. 396.



Schneeberg.

Cleavage, traces in the direction of the primary faces, as well as those parallel with the cube and dodecahedron; the first, a little the most distinct. Fracture uneven. Surface

* A considerable quantity of this rare mineral was a few years since brought from the western coast of South America to Baltimore, to be smelted, from whence it was re-shipped to England, before its true nature was detected by the mineralogists of this country.

Smaltine.

generally pretty smooth; the faces of the cube often curved. Subject to tarnish.

Lustre metallic. Color tin-white, inclining to steel-grey. Streak greyish-black.

Brittle. Hardness = 5·5. Sp. gr. = 6·466, a cleavable variety.

Compound Varieties. Reticulated and other imitative shapes; the individuals of them being often discernible. Massive: composition granular, individuals of various sizes.

1. Heated in an open tube, it emits a good deal of arsenious acid. On charcoal, before the blow-pipe, it yields a strong smell of arsenic, and melts into a greyish-black pearl, which is magnetic. With borax and salt of phosphorus, it produces a sapphire-blue glass. In powder, with concentrated nitric acid, it immediately developes red fumes, attended with effervescence and the extrication of heat.

2. *Analysis.*

	By Stromeyer. fr. Riegelsdorf.	By John. fr. Schneeberg.	By Laugier. fr. Bieber.
Arsenic	74·22	65·75	68·50
Cobalt	20·31	28·00	9·60
Iron	3·42 (with mang.)	6·25	9·70
Copper	0·16	0·00 silica	1·00
Sulphur	0·89	0·00	7·00

3. It is principally met with in veins, traversing rocks of various ages, more rarely in beds. It is accompanied by ores of silver, or by ores of copper. In beds, it is attended by Mispickel and Copper-Nickel.

4. It is found in veins, traversing primitive rocks, at Schneeberg and Annaberg in Saxony; also at Freiberg and Marienberg; likewise at Joachimsthal in Bohemia, and in veins in killas, at Wheal Sparnon in Cornwall. The veins of the counties of Sayn and Siegen, which contain it, are included in greywacke; and those of Thuringia and Mansfeld, and of Riechelsdorf in Hessia, in cupriferous shale. It occurs in beds at Schladming in Stiria, at Orawitza in the Bannat, and at Dobschau in Hungary. But a single locality of Smaltine is known to exist in the U. States, which is at Chatham, (Conn.), where it occurs in veins traversing gneiss, accompanied by Mispickel and Copper-Nickel.

5. It is a valuable ore for the preparation of blue enamel-colors, and particularly for smalt.

SMARAGDITE. (See *Pyroxene.*)

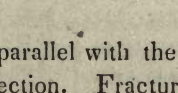
SOAPSTONE. (See *Talc.*)

SODA-ALUM. (See *Solfatarite.*)

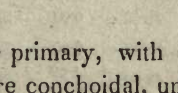
SODALITE. Dodecahedral Kouphone-Spar. MOHS.

Primary form. Rhombic dodecahedron.

Secondary forms.



1. Primary form, with the acute angles truncated. Lake Laach.



2. Cube, with edges truncated. Greenland.

Grains.

Cleavage, parallel with the primary, with different degrees of perfection. Fracture conchoidal, uneven. Surface even, though sometimes rough.

Lustre vitreous. Color greyish-black, passing into ash-grey and brown, sometimes a whitish play of light parallel to the planes of the cube, white passing to green and blue, the latter often deep azure-blue. Streak paler than the color. Transparent . . . translucent on the edges.

Brittle. Hardness = 5·5 . . . 6·0. Sp. gr. = 2·2 . . . 2·3.

Compound Varieties. Massive: composition granular, individuals strongly connected; fracture uneven.

1. The present species consists of what was once believed to constitute four different ones: 1. *Lapis-lazuli*, the deep azure blue massive varieties, commonly found along with massive Iron Pyrites; 2. *Haüyne*, crystallized in dodecahedra, and in grains of a bright blue color; 3. *Sodalite*, in white transparent crystals; 4. *Spinellane*, in ash-grey and brown crystals.

2. Before the blow-pipe, Lapis-lazuli melts with difficulty into a glassy globule, which is first of a bluish tinge, but soon becomes white. The compact varieties melt more easily, and with a slight effervescence. It is dissolved with considerable effervescence by borax, and forms with it a clear globule. If previously burnt and reduced to powder, it loses its color, and forms a jelly with acids. Hauyne melts into a vesicular glass, and loses its color. It effervesces if melted with glass of borax, and forms a transparent globule, which becomes yellow on cooling. Sodalite, before the blow-pipe, melts with intumescence and the developement of air bubbles, into a colorless, glassy globule: with borax, it melts with difficulty, and only when added in small proportion. Spinellane is infusible, whether alone, or with additions.

3. *Analysis.*

Analysts and varieties.	*Silica.*	*Magnesia.*	*Alumina.*	*Lime.*	*Potash & soda.*	*Oxide of iron.*	*Sulphuric acid.*
GMELIN. Lapis-lazuli.	49·00	2·00	11·00	16·00	8·00	4·00	2·00
ECKEBERG. Sodalite.	36·00	0·00	32·00	0·00	25·00	0·15	6·75 mur. acid
THOMSON. Sodalite.	38·52	0·00	27·48	2·10	25·50	1·00	3·00 mur. acid
GMELIN. Hauyne.	35·48	0·00	18·87	12·00	15·45 potash.	1·16	12·39
KLAPROTH. Spinellane.	43·00	1·00 sulphur	29·50	1·50	19·00 soda.	2·00	0·00

4. Lapis-lazuli has been brought from Lesser Bucharia, Thibet and China. It has lately been found at Lake Baikal in Siberia, in veins with Iron Pyrites, Feldspar and Garnet. Hauyne occurs at Albano and Frescati near Rome, among the products of Vesuvius; also in the neighborhood of Puy de Dome, on the Lake of Laach, in the quarries of Niedermeunich, and in several other places near Andernach, partly imbedded in pumice. Sodalite is found in West Greenland, in a bed in mica-slate, from six to twelve feet thick; and is accompanied by several species of Augite-Spar and Feldspar, as well as by Zircon and Eudyalite. It occurs likewise among the minerals ejected by Mount Vesuvius. Spinellane is found on the shores of Lake Laach, with Feldspar, Hornblende and Magnetic Iron-Ore.

5. The variety Lapis-lazuli is cut into various ornamental articles, as ring stones, snuff boxes, &c. It is manufactured into a very costly pigment, called Ultramarine.

SODA-NITRE. Rhombohedral Natron-Salt.

Primary form. Rhomboid. P on P = 106° 33′.

Cleavage, perfect parallel with the primary faces. Fracture conchoidal, almost imperceptible. Surface smooth.

Lustre vitreous. Color white. Streak white. Transparent.

Rather sectile. Hardness = 1·5 ... 2·0. Sp. gr. = 2·0964. Taste cooling.

Compound Varieties. In efflorescences.

1. It melts and deflagrates with a yellow light upon red-hot charcoal, but not so violently as Nitre. It is soluble in three times its weight of water, at 60° F. If rubbed in an isolated state, it acquires a very strong negative electricity.

2. *Analysis.*

By BERZELIUS.

Nitric acid - - - - - - - -	54·97
Soda - - - - - - - -	45·03

It contains a little sulphate of potash.

3. It is found in immense quantity in the district of Tarapaca in Peru, near the frontiers of Chili, three days' journey from La Conception, a port of Chili. It also comes from Iquiqui, a port in the south of Peru. In these countries, it forms a bed many feet thick, which in some places appears on the surface, occupying an extent of more than forty leagues. It is frequently mixed with clay and sand.

4. Very large quantities of this salt, purified by solution and crystallization, are carried into Europe, and imported into the United States.

SOLFATARITE. Prismatic Alum-Salt.

Massive; composition columnar, individuals thin, straight and parallel. Cleavage in one direction, perfect.

Lustre vitreous, to pearly. Color white; transparent to translucent.

Hardness = 2·0 ... 2·5. Sp. gr. = 1·88. Taste sweetish astringent.

1. It is more soluble in water than alum.

Solfatarite.

2. *Analysis.*

	By Thomson. from Mendoza, S.A.	By Boussingault. from Rio-Saldana.	By Hartwall. from Milo.	By Rose. from Copiapo.
Sulphuric acid	37·700	36·40	40·31	36·97
Alumina	12·000	16·00	14·98	14·63
Water	41·900	46·60	40·94	44·64
Soda	7·960	0·00	1·13	0·00
Potash	0·000	0·00	0·26	0·00
Silica	0·022	0·00	1·13	1·37
Lime	2·256	0·02	0·00	0·00
Peroxide of iron	0·207	0·04	traces.	2·58
Magnesia	0·796	0·00	0·85	0·14
Protox. manganese		0·00	0·00	0·00
Muriatic acid	0·100	0·00	0·400	0·00

3. This substance is found in the *solfataras* of Guadaloupe, the Lipari islands, at Milo and other islands in the Grecian archipelago; at Copiapo, a province of Coquimbo in Chili, where it forms with White Copperas a large mass; and at Mendoza near the foot of the Andes.

Sommervillite. (See *Idocrase.*)

Sommite. (See *Nepheline.*)

Sordawallite.

Massive: composition impalpable; no trace of cleavage. Fracture conchoidal.

Lustre vitreous, inclining to semi-metallic. Color greenish black or greyish black. Opake.

Brittle. Hardness, equal to that of glass. Sp. gr. = 2·53.

1. It becomes reddish by exposure to the atmosphere. Before the blow-pipe, it forms with difficulty a blackish globule. With a small quantity of soda, it yields a blackish green globule; with a larger quantity, a rough slaggy mass is produced. Borax dissolves it into a green glass. It is partly soluble in muriatic acid.

2. *Analysis.*

	By Nordenskiold.
Silica	49·40
Alumina	13·80
Peroxide of iron	18 17
Magnesia	10·67
Phosphoric acid	2·28
Water	4·38

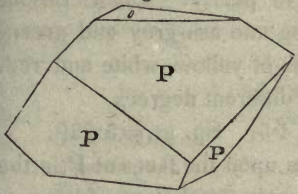
3. It occurs near the town of Sordawala in Finland, in layers from half an inch to one inch in thickness, in a primitive rock.

SPATHIC IRON. Brachytypous Parachrose-Baryte. Mohs.

Primary form. Rhomboid. P on P=107°.

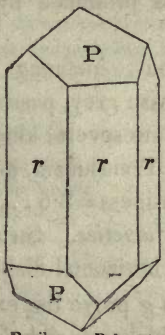
Secondary forms.

Fig. 397.



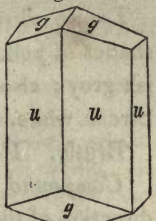
Przibram, Bohemia.

Fig. 398.



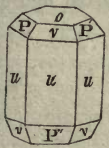
Przibram, Bohemia.

Fig. 399.



Wheal Maudlin, Cornwall.

Fig. 400.



Cornwall.

Fig. 401.

Cornwall.

Fig. 402.

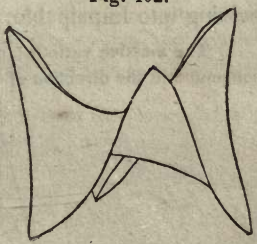


Fig. 397. Primary form, with the summits truncated.—Fig. 398. Primary form, with the lateral angles truncated.—Fig. 399. Similar to Fig. 398, but having the upper edges of the rhomboid so deeply truncated, as to give rise

to new planes g. g on $g = 136° 34'$.—Fig. 400. o on $v = 155'$. v on $v = 67° 20'$.

Cleavage, perfect parallel with P; rarely, traces of g. Fracture imperfectly conchoidal.

Surface, o generally rough; P often rounded, which terminates in the saddle shaped lens. Fig. 402. o streaked parallel to the edges of combination with P; u rough. The common lens is produced by continued striæ between g and P.

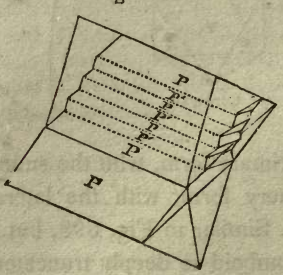
Lustre vitreous, inclining to pearly. Color various shades of yellowish grey, passing into ash-grey and greenish grey; also into several kinds of yellow, white and red. Streak white. Translucent, in different degrees.

Brittle. Hardness = 3·5 ... 4·5. Sp. gr. = 3·829.

Compound Varieties. Striæ upon the faces of P in the direction of the horizontal diagonals; and faces of composition parallel to g prove the existence of a regular composition. Botryoidal and globular shapes: composition columnar, surface drusy. Massive: composition granular, passing into impalpable.

1. The massive varieties of the present species are often regularly compound in the direction of the faces of g, as in the annexed figure.

Fig. 403.



It is sometimes possible to obtain from them by fracture the form of *g*, bounded on all sides by faces of composition, without presenting a single real face of cleavage. There is no distinct cleavage parallel to the face of *g*. The saddle shape lenses are in part composed of several individuals nearly in parallel position, but the axes of which are slightly diverging.

2. Before the blow-pipe, it becomes black, and acts upon the magnetic needle, but does not melt. It colors glass of borax green. It is soluble with difficulty, and effervesces but little in nitric acid, particularly if not reduced to powder. On being exposed to the air, it is gradually decomposed; first the color of the surface becomes brown or black; afterwards the streak is changed into red or brown, hardness and sp. gr. are diminished, and even the chemical constitution is altered, the whole being converted into hydrate of iron.

3. *Analysis.*

By KLAPROTH.

	A botryoidal variety.	A cleavable variety.
Protoxide of iron	63·75	57·50
Carbonic acid	34·00	36·00
Oxide of manganese	0·75	3·30
Lime	0·00	1·25
Magnesia	0·52	0·00

4. Spathic Iron is frequently found along with compound varieties of Calcareous Spar in beds in gneiss, mica slate, clay-slate and newer-rocks; sometimes with Limonite and Specular Iron, Heavy Spar, and other species. It likewise occurs in metalliferous veins, accompanied by Galena, Fahlerz, Iron Pyrites, &c. More rarely, it occurs in the cavities of trap rocks.

5. The beds in which the varieties of the present species are found in immense quantities in Stiria, Carinthia, and the bordering countries, form connected tracts, which extend along the chain of the Alps, on one side into Austria, and on the other into Salzburg. The celebrated Erzberg near Eisenerz, is situated in one of them At Freiberg, it is found in silver veins. It is found with Tin-Ore, at Ehrenfreidersdorf in Saxony, Wheal Maudlin, St. Just, and other places in Cornwall. It is also found, in more or less considerable masses, in Bohemia, Bayreuth, Würtemberg, Switzerland, France, Spain, and many other countries.

A very considerable vein of Spathic Iron exists in the United States, at Roxbury, (Conn.) which traverses in a vein of Quartz, a mountain of

gneiss for the distance of a mile. A bed of it also exists at Plymouth, (Vt.) It is found in small quantity at Lane's mine in Monroe, (Conn.)

Appendix to Spathic Iron.

i. *Kaminoxene Carbon-Spar.* Breithaupt.

P on P = 107°.

Cleavage, perfect parallel with P, traces parallel with *o*.

Hardness (scale of Breithaupt) = 5. Sp. gr. = 3·765.

1. It appears that 1 p. c. of oxide of manganese is essential to the present species. To it belongs the white Sparry-iron from Vorgtlande, from Bayreuth, and from Siegen in Prussia.

ii. *Olizone Carbon-Spar.* Breithaupt.

P on P = 107° 3′.

Cleavage, parallel with P perfect.

Hardness (scale of Breithaupt) = 5·0 . . . 5·25.

Sp. gr. = 3·7453, from Ehrenfriedersdorf.

Analysis.

By Magnus.

Carbonate of iron - - - - - - -	59·99
Carbonate of manganese - - - - - -	40·66

iii. *Allotroposè Carbon-Spar.* Breithaupt.

P on P = 107° 11½′.

Cleavage, parallel with P perfect.

Hardness (scale of Breithaupt) = 5·25 . . . 5·50.

Sp. gr. = 2 992, from Hall in Tyrol.

= 3·001, a liver-brown variety.

Analysis.

By Stromeyer.

Carbonate of magnesia - - - -	89·70
Carbonate of iron - - - -	8·02
Carbonate of manganese - - - -	2·44

iv. *Mesitine Carbon-Spar.* Breithaupt.

P on P = 107° 14′.

Cleavage, parallel with P very perfect; traces parallel with *o*.

Color dark greyish and yellowish grey. Transparent and translucent.

Hardness (scale of Breithaupt) = 5·00.

Spathic Iron—Specular Iron.

Sp. gr. $= \left\{ \begin{matrix} 3{\cdot}350 \\ 3{\cdot}363 \end{matrix} \right\}$ from Traversella, Piedmont.

1. Before the blow-pipe it decrepitates; in muriatic acid, and in nitric acid, a feeble effervescence takes place, but it is entirely soluble. It probably contains magnesia, lime, protoxide of iron, and oxide of manganese.

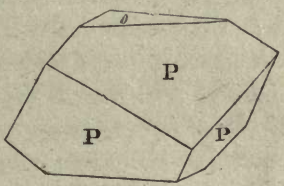
2. It occurs at Freiberg, as well as in Piedmont and the island of Elba.

SPECULAR IRON. Rhombohedral Iron-Ore. Mohs.

Primary form. Rhomboid. P on P=85° 58′ ... 86° 10′.

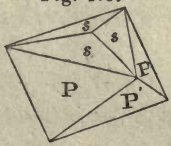
Secondary forms.

Fig. 404.



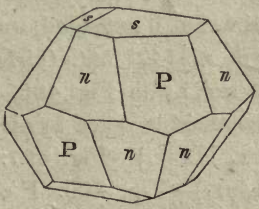
Vesuvius.

Fig. 405.



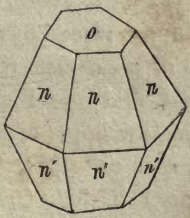
Elba.

Fig. 406.



Framont.

Fig. 407.



Elba.

Specular Iron.

Fig. 408.

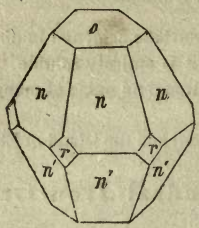
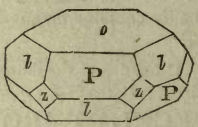
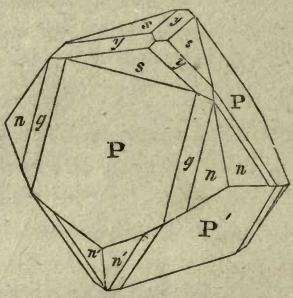


Fig. 409.



Framont.

Fig. 410.



Elba.

Fig. 404. Primary form with summits truncated. P on $o=122° 40'$. (*basé*, Hauy.)—Fig. 205. Primary, with the summits replaced by three planes, which, if extended, would lead to an obtuse rhomboid. s on $s=142° 56'$. (*birhomboidal*, Hauy.)—Fig. 406. The same with Fig. 405, but having the upper edges of the rhomboid bevelled by planes n. n on $n=128°$. (*binoternaire*. Hauy.)—Fig. 407. n on $o=119° 34'$. (*trapézien*. Hauy.)—Fig. 409. P on $b=113° 32°$. o on $z=90°$. (*equivalent*, Hauy.)—Fig. 410. n on $y=138° 53'$. P on $g=166° 25'$. *equipollent*, Hauy.)

Specular Iron.

Cleavage, parallel with P and *o*. In some varieties scarcely any traces appear, while in others it seems to be perfect, which however, must in a great measure be attributed to composition. Fracture conchoidal, uneven. Surface, *s* is horizontally streaked, sometimes so deeply that it appears rounded; P is sometimes streaked parallel to the edges of combination with *n*; *y* is uneven, and often curved.

Lustre metallic. Color dark steel-grey, iron-black. Streak cherry-red, reddish brown. Surface frequently tarnished; generally with the exception of *o*, which may be useful in finding the true position of the crystals, when they become complicated. Opake; very thin laminæ are faintly translucent, and show a deep blood red color.

Brittle. Sometimes feeble action upon the magnetic needle. Hardness=5·5 . . . 6·5. Sp. gr.=5·251, a crystalline variety from Sweden.

Compound Varieties. Twin-crystals. 1. Axis of revolution perpendicular; face of composition parallel to *o*; the individuals are continued beyond the face of composition. (Altenberg, Saxony.) Sometimes two individuals in the same position are joined in a face of *n*, and terminate at this face. (Stromboli.) 2. Axis of revolution perpendicular, face of composition parallel to a face of P.

Globular, reniform, botryoidal, and stalactitic shapes: surface generally smooth, composition more or less thin columnar, sometimes even, impalpable; in this case the lustre becomes imperfectly metallic, and the color red; fracture of impalpable compound varieties, even, flat conchoidal, or uneven. Compound varieties often join in a second and third composition, which are curved lamellar and granular; the junction of granular masses produces frequently very

smooth faces, while the reniform surface of the curved lamellar compositions is rough, and obtained with more difficulty, by separating the particles, than the first. Massive: composion, 1. Columnar, generally imperfect, thick, and diverging from common centres. 2. Granular, and often impalpable; sometimes very distinct and easily separated; often, however, they are strongly coherent: if they are impalpable, their lustre decreases, their color becomes red, and the fracture even, uneven, or flat conchoidal. 3. Lamellar, joined in the face of *o*, thick and variously bent; sometimes, however, they are so thin, that they allow blood-red light to pass; if they are still thinner, their color becomes red altogether, and their lustre imperfectly metallic; the faces of composition are often irregularly streaked. When the cohesion among the particles is diminished, the lamellar varieties become scaly and glimmering, the granular ones earthy and dull. Pseudomorphoses in the shape of Calcareous Spar, Fluor, &c.

1. Owing to a want of attention to the simple and compound state of he contents of the present species, has arisen its subdivision into two species by the majority of mineralogists; viz. into *Specular Iron-Ore* and *Red Iron-Ore*. Specular Iron contains all the simple varieties, and those of the compound ones which have not lost their metallic appearance by the too small size of their component individuals. Those in thin lamellar compositions have been called *Micaceous Specular Iron*, while the rest form the *Common Specular Iron*. Those varieties which have lost their metallic appearance, are included within the *Red Iron-Ore*, divided into *Fibrous* Red Iron or *Red Hematite*, which occurs in reniform and other imitative shapes, and consists of columnar particles of composition; into *Compact* and *Ochrey* Red Iron, which are massive, and consist of impalpable, granular individuals, more or less firmly connected; and into *Scaly* Red Iron, or *Red Iron-Foam*, consisting of very small scaly particles, which in most cases are but slightly coherent. This variety is in immediate connexion with the micaceous

Specular Iron.

Specular Iron, between which and the crystallized Specular Iron there exists an uninterrupted transition. Among the varieties of *Clay Iron-Ore*, the following may be considered as an appendix to the present species, all of which are of a red color, but more or less impure, and mixed with earthy substances. Reddle possesses an earthy, coarse slaty fracture; it soils and writes, and may be used as a drawing material. *Jaspery Clay Iron-Ore*, has an even or large flat conchoidal fracture, and a hardness which is considerable, if compared with other minerals of a similar formation. *Columnar* and *Lenticular Clay Iron-Ore* are distinguished, the first by the columnar form, the latter by the flattish granular form of its particles of composition.

2. Specular Iron is infusible before the blow-pipe, but melts with borax, and forms a green or yellow glass, like pure oxide of iron. It is likewise soluble in heated muriatic acid.

3. *Analysis.*

Analysts.	Varieties and localities.	Ox. of iron.	Ox. mang.	Si-lica.	Lime.	Alu-mina.	Wa-ter.	To-tal.
Bucholz.	Micaceous Iron-Ore.	100·00	0·0	0·00	0·0	0·00	0·0	100·00
D'Aubisson.	Red Hematite. Framont.	90·00	trace.	2·00	1·0	0·00	3·0	96·00
"	" " "	94·00	trace.	2·00	trace.	0,00	2.0.	98·00
Bucholz.	Compact Red Iron.	100·00	0·0	0·00	0·0	0·00	0·0	100·00
Lampadius.	Compact Red Iron.	65·40	2·7	20·70?	0·0	9·3	0·0.	98·10
Bucholz.	Red Iron-Foam.	100·00	0·0	0·00	0·0	0·0	0·0	100·00
Henry.	" " "	94·50	0.0	4·25?	0·0	1·25	0·0	100·00

The clay iron-ores, being more or less mixed with earthy substances, vary in their contents, and several of their properties are dependent upon the nature of these admixtures. Thus lenticular clay iron-ore is very rich, while the columnar variety contains but little iron, and is produced from nodules of common clay, which have been converted by the influence of heat from burning coal seams, the one into columnar clay iron-ore, the other into porcelain Jasper.

4. It occurs most commonly in beds and veins in ancient rocks. Clay iron-ore forms either by itself beds in secondary mountains, or it is included in beds of clay in the shape of nodules or irregular masses. Specular Iron-Ore occurs in crystals among the rocks ejected by Vesuvius, and lining the cavities and fissures of lava, where it seems to be a product of sublimation. In beds, it is generally accompanied by other ores of iron, several species of earthy minerals, as Epidote, Hornblende and Augite, Calcareous Spar and Quartz.

5. The most beautiful crystals hitherto known, for size and form, are found in the island of Elba, along with Iron Pyrites and Quartz. Splendid geodes of crystals also come from Framont in Loraine, St. Gothard in Switzerland, and Dauphiny; at the last mentioned place, they occur in veins in primitive rocks. Other localities are, the vicinity of Vesuvius and the island of Stromboli, Norway, Sweden and Stiria. Micaceous Iron-Ore is very common in the beds of Spathic Iron, in Stiria and Carinthia. Red Iron-Ore is found in Saxony, Bohemia, the Hartz, the Fichtelgebürge, at Ulverstone in Lancashire, and other places in England, and in many other countries. Jasper clay iron-ore is almost entirely confined to Lower Austria; the columnar variety occurs in several localities of the north of Bohemia, in the countries of Elbogen and Leitmeritz; the lenticular Clay Iron-Ore forms a bed in the transition district of Central Bohemia, in the counties of Pilsen, Beraun, &c.

But few localities of crystallized Specular Iron are known in the U. States. What was believed to be Specular Iron, from Amity, (N. Y.), and which occurs along with Spinel in limestone and Serpentine, is Crichtonite. Druses of lenticular or micaceous crystals, are found at Fowler, St. Lawrence co. (N.Y.) The Micaceous Iron, in large masses, consisting of thin waved laminæ, themselves composed of the finest scales, occurs at Hawley, (Mass.) Red Hematite is found at Ticonderoga, upon Lake George; and Lenticular clay-Iron ore is abundant throughout the western part of New York. Pebbles of compact Red Iron-Ore are found throughout the hills in the vicinity of Marietta, (Ohio.)

6. Specular Iron is an ore of the highest importance, and yields a considerable proportion of the iron annually produced in the different quarters of the globe. Red Hematite, sometimes also, compact Red Iron-Ore, are used for polishing metals, and Reddle as a writing material.

SPHENE. Prismatic Eruthrone-Ore.

Primary form. Oblique rhombic prism. M on M = 133° 30′. P on M = 121° 50′.

Sphene.

Secondary forms.

Fig. 411.

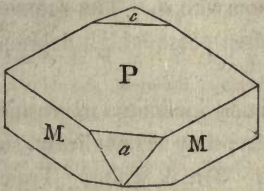
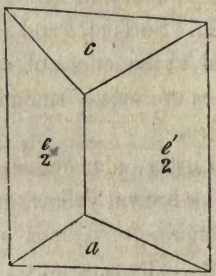
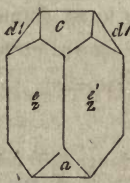


Fig. 412.



Arendal, Norway—Roger's Rock, Lake George.

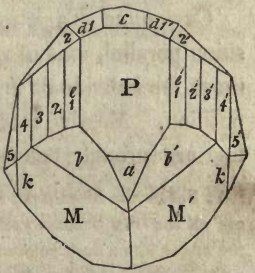
Fig. 413.



Arendal, Norway—Roger's Rock, Lake George.

Fig. 414.

Fig. 415.



St. Gothard.

PHILLIPS.

P on *a*	159°	44′	M on *c*	120°	2′
P on *c*	140	52	*b* on *b*	167	0
P on *e*2	158	18	*b* on *c*	139	30
P on *e*3	154	20	*c* on *d*1	146	44
P on *e*4	146	30	*c* on *e*2	145	18
P on *e*5	120	2	*c* on *e*4	154	52
M on *a*	139	30	*d*1 on *d*1′	113	24
M on *b*	124	35	*d*2 on *d*2′	135	60
M on *c*	86	20	*d*2 on *e*4	152	30
M on *e*2	119	35	*d*1 on *e*2	152	45
M on *e*3	116	42	*e*1 on *e*1′	175	42
M on *e*5	138	42	*e*2 on *e*2′	136	40
M on *l*	151	20	*e*4 on *e*4′	113	50

Sphene.

Cleavage sometimes distinct in the direction of *d*: traces parallel with M. Fracture imperfectly conchoidal, uneven. Surface, *b* and M almost always faintly streaked, parallel to the edges of combination with *d*. The remaining faces are mostly smooth, and often possess high degrees of lustre.

Lustre adamantine, sometimes inclining to resinous. Color brown, yellow, grey, green; they are not lively, some pistachio-green ones excepted. Streak white. Translucent . . . translucent on the edges.

Hardness = 5·0 . . . 5·5. Sp. gr. = 3·468, of a massive yellowish grey variety from Norway.

Compound Varieties. Twin-crystals: faces of composition parallel, axis of revolution perpendicular to *c*; sometimes the individuals are continued beyond the face of composition. Massive: composition granular or lamellar, the first are strongly connected.

1. Before the blow-pipe, the yellow varieties do not change their color; all the rest become yellow. They intumesce a little, and melt on the edges into a dark colored enamel. They are soluble in heated nitric acid, leaving behind a siliceous residue.

2. *Analysis.*

	By KLAPROTH.	By CORDIER.
Lime	33·00	32·20
Oxide of titanium	33·00	33·30
Silica	35·00	28·00
Oxide of manganese	a trace	0·00

3. Sphene occurs in small nodules or crystals imbedded in gneiss and beds of sienite and other trap rocks, belonging to them, or to more recent classes of mountains. It is met with in metalliferous beds with ores of iron, several species of Augite Spar and Feldspar: likewise in beds of primitive limestone, and in veins which traverse primitive rocks.

4. It occurs in several districts of the Saualpe in Carinthia, imbedded in coarse grained gneiss; at Hafnerzell in the district of Passau, it occurs

in a bed in gneiss, consisting almost entirely of Augite Spars and Feldspars. At Windisch-Kappel in Carinthia and near Dresden in Saxony, in similarly compound rocks of a newer date. It occurs in beds of iron ore at Arendal in Norway; in veins at St. Gothard in Switzerland, in the Felberthal in Salzburg, and in many other places in the Alps. It is found besides, in France and at several places in Scotland. It occurs in Canada, at Grenville associated with Tabular Spar and Plumbago.*

It is found in the greatest abundance in the United States, at Roger's Rock on Lake George, disseminated in small brown crystals through an aggregate of Feldspar and Pyroxene. A similar variety is found, crystallized and massive, in nodules and geodes with Pyroxene and Petalite, in the limestone of Bolton, (Mass.) In small quantity also, in rounded grains and imperfect crystals, disseminated through limestone with Hornblende, &c., at Edenville and Amity, (N. Y.), and at Trumbull, (Conn.)

Spherosiderite. (See *Spathic Iron.*)

Spherostilbite.

Massive: globules formed in vesicular cavities. Composition columnar, radiating from the centre.

Lustre pearly, very brilliant on the fracture.

Fibres flexible. Surface of the globules scratched by the nail. Sp. gr. $=2{\cdot}31$.

1 Fusible before the blow-pipe, with exfoliation and effervescence. Forming a jelly with the acids. The solution yields a precipitate with the oxalate of ammonia.

2. *Analysis.*

By Beudant.

from Faroe.

Silica	55·91
Alumina	16·61
Lime	9·03
Soda	0·68
Water	17.84

* The specimens from this locality cleave constantly and with great perfection, parallel with a rhombic prism of 123° 30′, which is oblique from an acute edge.

3. It occurs, implanted upon Stilbite from Faroe.

4. Its properties as given above, do not appear to justify the formation of a new species.

SPHERULITE. (See *Pitchstone.*)

SPINEL. Dodecahedral Corundum. MOHS.

Primary form. Regular octahedron.

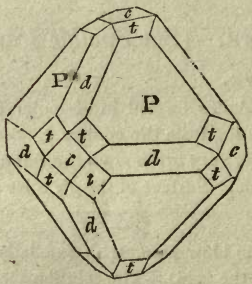
Secondary forms.

1. Primary with edges truncated. Hamburg, (N. J.)

2. Primary with edges bevelled. Vesuvius.

3. Primary with edges and angles truncated. Hamburg, (N. J.)

4. Fig. 416.



Hamburg, (N. J.)

5.

Primary with edges replaced by three planes, and angles by four planes resting on the primary faces.

Vesuvius.

Cleavage parallel with the primary form difficult. Fracture conchoidal. Surface smooth, the faces *t* sometimes striated parallel to the edges of combination with the octahedron.

Lustre vitreous. Color red, passing into blue and green, also into yellow, brown and black. Sometimes nearly

Spinel.

white. Streak white. Transparent . . . translucent, only on the edges, if the color be very dark.

Hardness $=8{\cdot}0$. Sp. gr. $=3{\cdot}523$, of a transparent variety, between cochineal-red and carmine-red.

Compound Varieties. Twin-crystals, face of composition parallel, axis of revolution perpendicular to a face of the octahedron. Sometimes parallel to several faces of the octahedron.

1. The red varieties, exposed to heat, become black and opake; on cooling they appear first green, then almost colorless, and at last, reassume their red color. With borax, they fuse with difficulty, with salt of phosphorus a little more easily. The dark colored varieties yield a deep green globule. Spinel assumes positive electricity by friction.

2. *Analysis.*

Analysts.	Varieties and localities.	Alumina.	Silica.	Magnesia.	Oxide of iron.	Lime.	Total.
Berzelius.	Blue, Aken.	72·250	5·450	14·830	4·260	0·000	96·58
Klaproth.	Red.	74·500	15·500	8·250	1·500	0·750	98·50
Descotils.	Greenish black, Ceylon.	68·000	2·000	12·000	16·000	0·000	98·00
Thomson.	Green, Hamburg, (N. J.)	73.308	5.620	13·622	7·420 protox.	trace	99·98
Thomson.	Black, Amity, (N. Y.)	61·788	5·596	17·868	16·564 protox.	2·804	98·72
Abich.	Black, Vesuvius.	67·460	2·380	25·950	5·060 protox.	1·100	100·00
Abich.	Red? Ceylon.	69·010	2·020	26·210	0·710	1·100 protox. chrome.	

3. Crystals from Ceylon and from several places in the United States, occur imbedded in white limestone. It is found also in veins with Calcareous Spar in serpentine, and in gneiss. Other varieties belong to druses in volcanic rocks. Besides which, it is found abundantly in more recent deposits, formed by diluvial or alluvial action, along with crystals of Corundum, Zircon and other gems.

4. The red, transparent crystals are almost exclusively brought from Ceylon, where they occur in the sand of rivers. In Südermanland in Sweden, bluish and pearl-grey varieties occur imbedded in granular limestone. Dark colored crystals, called *Pleonaste*, are found in Ceylon in sand, and in implanted crystals on Vesuvius.

The United States afford some very remarkable varieties of the present species; the most distinguished of which is one of a black color in crystals, varying from one to sixteen inches in circumference, which is found at Amity, (N. Y.) These crystals exist in groups, often lining the sides of partial veins with Calcareous Spar and Crichtonite in serpentine. They are often in twin-crystals. The same neighborhood produces an abundance of smaller crystals of various shades of green, black, red and brown, and which are imbedded in granular limestone, usually associated with Brucite, Hornblende and Pyroxene. The secondary forms above quoted are found at Hamburg, (N. J.) where they are found in Calcareous Spar and Quartz, associated with Scapolite. They present rich shades of green and blue, and frequently the crystals are transparent. Pearl-grey crystals, simple and compound are found at Newton, (N. J.) in limestone accompanying the blue Corundum, Tourmaline and Rutile. Black Spinel has been found at Munroe, (N. Y.) Green and blue, and more rarely red varieties occur in Bolton, Boxborough and Littleton, (Mass.) imbedded in white limestone.

SPINELLANE. (See *Sodalite*.)

SPODUMENE. Prismatoidal Disthene-Spar.

Primary form. Oblique rhombic prism. M on M = 93°.

Cleavage, parallel to the shorter diagonal of the prism, perfect also to bases oblique to the obtuse edge of the prism and forming with it angles of 135° ... 138°, less perfect than the former. In distinct cleavages also, apparently forming tangent truncations of the acute solid angles. Fracture uneven.

Lustre pearly. Color various shades of greyish-green; passing into greenish-white. Streak white. Translucent.

Brittle. Hardness = 6·5 ... 7·0. Sp. gr. = 3·170.

Compound Varieties. Massive: composition granular, of various sizes of individuals, generally large.

Spodumene.

1. If exposed to the heat of the blow-pipe, it loses transparency and color, intumesces, exfoliates and then melts into a nearly colorless transparent glass.

2. *Analysis.*

	By Arfvedson.	By Thomson. from Ireland.
Silica	66·40	63·313
Alumina	25·30	28·508
Lithia	8·85	5·604
Oxide of iron	1 45	0·728
Oxide of manganese	0·00	0·828

3. It occurs in primitive rocks, particularly in granite, associated with Quartz, Mica, Albite and Tourmaline.

4. It was first discovered at Utön in Sudermanlan, Sweden; but was afterwards found also at Sterzing in the Tyrol, and Killiney in Ireland.

It was first found in the United States, at Goshen, (Mass.) though it passed for some time under the name of Augite. Two deposits of it exist in that town, both of which are in granite; at one of them, it is associated with blue Tourmaline and Beryl. It exists also in the neighboring town of Chesterfield, and at Sterling, in the same state.

Appendix to Spodumene.

1. *Killinite.* The mineral described under this name, is found at Killiney near Dublin in Ireland, associated with Spodumene, with which it agrees in the cleavages, and from which it differs in hardness and sp. gr. Its hardness = 4·00 and Sp. gr. = 2·698. These differences however, appear to depend upon incipient decomposition. Before the blow-pipe it becomes white, intumesces and melts into a white enamel.

Analysis.

	By Barker.	By Lehunt.	By Blythe.
Silica	52·49	49·08	47·975
Alumina	24·50	30 60	31·041
Potash	5·00	6·72	6·063
Protoxide of iron	2·49	2·27	2·328
Lime	0·00	0·68	0·724
Magnesia with manganese	0 00	1·08	0·459
Protoxide of manganese	0·75	0·00	1·255
Water	5·00	10·00	10·000

Its difference in composition from the Spodumene, it will be seen, arises from the presence of water, and the substitution of potash for lithia.

STAUROTIDE. Prismatoidal Garnet. Mohs.

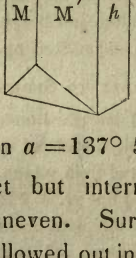
Primary form. Right rhombic prism. M on M = 129° 31′.

Secondary forms.

1.

Primary form with the acute lateral edges truncated.

2. Fig. 417.



M on a = 137° 58′.

Cleavage, h perfect but interrupted, M in traces. Fracture conchoidal, uneven. Surface P sometimes very rough and corroded, hollowed out in the centre. The rest of the faces generally of the same quality either rough or smooth.

Lustre vitreous, inclining to resinous. Color reddish-brown, or brownish-red, very dark. Streak white. Translucent, frequently on the edges.

Hardness = 7·0 . . . 7·5. Sp. gr. = 3·724, crystals from St. Gothard; that of columnar twin-crystals from Spain, the substance of which is less homogeneous, is between 3·3 and 3·4.

Staurotide.

Compound Varieties. Twin-crystals. Face of composition parallel, axis of revolution perpendicular to the longer diagonal of the prism. Angle of revolution =90; fig. 418. Face of composition parallel, and axis of revolution perpendicular to a face replacing the terminal edges, angle of revolution = 60, fig. 419. The individuals in both cases, are continued beyond the face of composition, and produce cruciform groupes. By the addition of a third individual to the latter, groupes resembling stars with six radii, are formed.

Fig. 418.

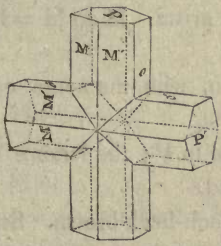
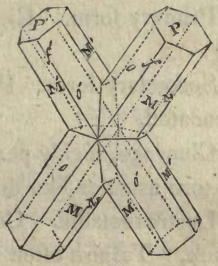


Fig. 419.



1. Before the blow-pipe this species does not fuse, but only assumes a dark color.

2. *Analysis.*

	By Vauquelin. from Brittany.	By Klaproth. from St. Gothard.
Silica	33·00	37·50
Alumina	44·00	41·00
Lime	3·84	0·00
Magnesia	0·00	0·50
Oxide of iron	13·00	18·25
Oxide of manganese	1·00	0·50

3. It occurs in imbedded crystals in primitive rocks, particularly in mica-slate, in simple and compound crystals, accompanied by Kyanite, Garnet, &c.

4. Simple crystals occur on St. Gothard in Switzerland, and the Greiner Mountain in Zillerthal in the Tyrol, sometimes curiously aggregated

with crystals of Kyanite, into a continuous mass with parallel axes, the perfect planes of cleavage of the two crystals being coincident. Twin-crystals occur in Spain, Portugal, France, Scotland and Brazil.

It is particularly abundant in the mica-slate region of the United States. The most interesting localities for the size and perfection of its crystals are, Franconia, (N. H.) New York, three and a half miles from the city, Bolton and Tolland, (Conn.) Chesterfield, (Mass.) Harpswell and Winthrop, (Maine.)

STEATITE. (See *Talc.*)

STEINHEILITE. (See *Iolite.*)

STERNBERGITE. Monotomous Polypoione-Glance.

Primary form. Right rhombic prism. M on M = 119° 30′.

Secondary form. Primary form, with the acute edges truncated.

Cleavage, highly perfect parallel to P; the laminæ may be torn asunder like thin sheet-lead.

Lustre metallic. Color dark pinch-beck brown. Streak black. Tarnish often violet-blue.

Very sectile. Thin laminæ perfectly flexible. Hardness = 1·0 . . . 1·5. Sp. gr. = 4·215.

Compound Varieties. Globular, or rose-like aggregations. Massive: composition granular.

1. Alone on charcoal, it burns with a blue flame and sulphurous odor, and melts into a globule generally hollow, with a crystalline surface, and covered with metallic silver. The globules act strongly on the magnetic needle.

2. *Analysis.*
By ZIPPE.

Silver	33·20
Iron	36·00
Sulphur	30·00

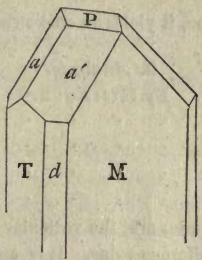
3. It is found along with other ores of silver, at Joachimsthal in Bohemia.

STILBITE. Prismatoidal Kouphone Spar. Mohs.

Primary form. Right rectangular prism.

Secondary form.

Fig. 420.



Faroe.

M on a'	-	-	120° 30′	Phillips.
a on a'	-	-	118 50	"
M on d	-	-	133 30	"

Cleavage, parallel to M and T, the former of which, only is perfect. Fracture uneven. Surface P often curved, M vertically streaked, T still more so.

Lustre vitreous. The faces M, both as faces of crystallization and of cleavage, exhibit a perfect pearly lustre. Color white prevalent, various shades of yellow, red and brown. Streak white. Semi-transparent . . . translucent.

Brittle. Hardness = 3·5 . . . 4·0. Sp. gr. = 2·161, white crystals from Iceland.

Compound Varieties. Twin-crystals which assume a cruciform aspect, but rare. The crystals are frequently aggregated in the form of a sheaf. Implanted globules, surface very drusy, composition, imperfectly columnar, and

strongly cohering. Massive: composition imperfectly columnar, individuals broad, straight, and radiating from common centres strongly coherent. Often these compositions are again aggregated into granular masses. Globular shapes formed in vasicular cavities.

1. Before the blow-pipe, it yields an opake vesicular globule. It does not gelatinize with acids.

2. *Analysis.*

By HISINGER.

Alumina	16·10
Silica	58·00
Lime	9·20
Water	16·40

3. Its principal repositories are, the vesicular cavities of amygdaloidal rocks, and certain metalliferous veins. It is also found lining seams in gneiss. The accompanying minerals are Heulandite and Chabasie, and when in metallic veins, it is generally attended by ores of silver, lead, copper and iron.

4. Magnificent crystals of a white color are met with in the vesicular cavities of the amygdaloids of Iceland and the Faroe Islands. Similar varieties have been brought alsofrom Indore in the Vendyah mountains in the East Indies. Those from the Tyrol are mostly compound and of a brick-red color. Beautiful crystals of this color occur near Campsie in Sturlingshire, though the present species is less common in Scotland and the Western Isles, than that of Heulandite. The crystals from the silver veins of Andreasberg in the Hartz are generally small, so are also those which occur in the iron mines of Arendal and in the beds of copper-ore in the Bannat of Temeswar. Handsome varieties of a white color occur in the Basin of Mines, Nova Scotia, in trap, attended with other species of this family.

But few localities of Stilbite are known in the United States; and these generally unimportant. The most interesting is that at Hadlyme, (Conn.) where it lines the walls of seams in gneiss in stellular concretions of considerable dimensions, associated with Chabasie, Heulandite and Epidote. Under similar circumstances, it occurs at West Farms, (N. Y.) and Bellows falls, (Vt.) It has been met with at Saybrook in gneiss in small reddish crystals associated with Molybdenite. Also in small quantity, in vesicular cavities of greenstone trap at various places in Connecticut and Massachusetts.

Stromeyerite.

STILPNOMELAN.

Massive; composition laminar and granular. Cleavage in one direction perfect.

Lustre vitreous. Color black. Streak, olive-green to liver-brown.

Hardness = 3·0 ... 4·0. Sp. gr. = 2·769, BREITHAUPT, 3·0 ... 3·4, GLOCKER.

1. It is found at Obergrund in Silesia.

STILPNOSIDERITE. (See *Limonite*.)

STRIEGISAN.

Primary form. Right rhombic prism. M on M = 122° 15′.

Secondary form, the obtuse angles of the primary form replaced so as to give rise to dihedral summits inclining to each other under angles of 107° 26′, and the lateral edges also replaced.

Cleavage parallel to the sides and the shorter diagonal of the primary form.

Lustre vitreous to pearly. Color grey, brown and black.

Hardness (scale of BREITHAUPT,) = 6·0 ... 7·0. Sp. gr. = 2·354 ... 2·379.

1. It is found at Striegis in Frankenberg.
2. It is probably identical with Wavellite.

STROMEYERITE. Uncleavable Polypoione-Glance.

Massive: composition impalpable. Fracture flat conchoidal to uneven.

Lustre metallic. Color blackish lead-grey. Streak shining.

Hardness = 2·5. Sp. gr. = 6.225.

1. It fuses very easily before the blow-pipe, attended with the odor of sulphureous acid, but without effervescence or the formation of a scoria. The globule has a grey color, a metallic lustre, is tarnished on the upper side, is semi-ductile and grey within. It is soluble in nitric acid; the solution affording the indication of copper on the immersion of an iron-plate, and of silver on the introduction of a copper one.

2. *Analysis.*

By STROMEYER.

Sulphur	15·96
Silver	52·87
Copper	30·83
Iron	0.34

3. It is found in small masses in the mines of Schlangenberge in Siberia.

STROMNITE.

Massive; composition thin columnar, and showing traces of crystallization.

Color yellowish-white internally; on the outside where it appears to be disintegrated, it is greyish-white. Lustre inclining to pearly, faint. Translucent.

Brittle. Hardness =3·5. Scratches Calcareous Spar, but not Fluor. Sp. gr. = 3 703.

1. It effervesces with acids, but is infusible before the blow-pipe.

2. *Analysis.*

By TRAILL.

Carbonate of strontita	68·6
Sulphate of barytes	27·5
Carbonate of lime	2·6
Oxide of iron	0·1

3. It occurs in veins with Galena in a kind of clay-slate, at Stromness in Orkney.

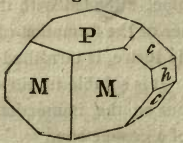
4. It seems probable that the Stromnite is a mixed mineral, consisting of an intimate aggregation of Strontianite and Heavy-Spar.

STRONTIANITE. Peritomous Hal-Baryte. MOHS.

Primary form. Right rhombic prism. M on M = 117° 32′.

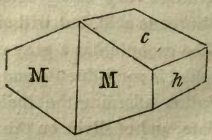
Secondary forms.

Fig. 421.



Braundsdorf, Saxony.

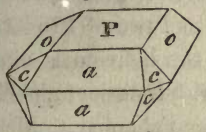
Fig. 422.



Leogang, Salzburg.

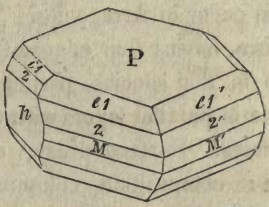
Strontianite.

Fig. 423.



Schoharie, (N. Y.)

Fig. 424.



M on *h*	-	-	121°	30′	PHILLIPS.
e′ on *e*1	-	-	108	12	"
*e*1 on *e*2	-	-	144	20	"
h on *c*1	-	-	126	5	"
h on *c*2	-	-	143	30	"
*c*1 on *c*2	-	-	160	35	"

Cleavage, parallel with M rather perfect; with *c* less easily obtained, faint traces observable in the direction *h*, or at least, small conchoidal fracture. Fracture in other directions, uneven. Surface P often rough, though even, and streaked, parallel to the edges of combination with *c*. M deeply streaked in a horizontal direction, and hence the crystals often in curved, barrel-shaped, prisms. The other planes generally smooth.

Lustre vitreous, slightly inclining to resinous upon the uneven faces of fracture. Color asparagus-green, and apple-green; pale yellowish-brown, yellow and grey; white. Streak white. Transparent . . . translucent.

Brittle. Hardness = 3·5. Sp. gr. = 3·605, the variety in acicular crystals from Bräunsdorf, near Frieberg.

Compound Varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel to a face of M. The individuals generally continued beyond the face

of composition. This composition is very similar to some that occur in Arragonite. The product of it is a six-sided prism, having four edges of 117° 19′ and two of 128° 22′. As in that species, particles of the two individuals alternate in parallel layers with each other. Indistinct globular masses. Surface drusy, composition columnar. Massive: composition columnar, the individuals generally straight, long and a little divergent; the composition is seldom granular.

1. It melts before the blow-pipe at a temperature not very elevated, but only on the thinnest edges. It intumesces and spreads a brilliant light, the flame at the same time assumes a reddish hue. It is dissolved by borax with a violent effervescence into a clear globule. It is soluble with effervescence in muriatic and nitric acids: and paper dipped into this solution and afterwards dried, will burn with a red flame.

2. *Analysis.*

By KLAPROTH.

Strontita	69·50
Carbonic acid	30·00
Water	00·50

3. The repositories of this species, are metallic veins traversing primitive and transition mountains. It seems also to occur in beds.

4. It was first discovered at Strontian in Argyleshire in Scotland, and found afterwards at Braunsdorf in Saxony in large crystals, at Leogang in Salzburg, and also in Peru. It has of late been found, in abundance at Schoharie, (N. Y.) disseminated in geodes and nests through water-limerock; also in large veins or beds. In one of these last, it exists in a mass of such extent and purity as to have attracted attention as a marble quarry.

SULPHATE OF ALUMINE. (See *Solfatarite.*)

SULPHATE OF AMMONIA. (See *Mascagnine.*)

SULPHATE OF BARYTES. (See *Heavy Spar.*)

SULPHATE OE COBALT. (See *Cobalt-Vitriol.*)

SULPHATE OF COPPER. (See *Blue-Vitriol.*)

SULPHATE OF IRON. (See *Copperas, Pittizite White Copperas* and *Yellow Copperas.*)

SULPHATE OF LEAD. (See *Anglesite.*)

SULPHATE OF LIME. (See *Gypsum.*)

SULPHATE OF MAGNESIA. (See *Epsom-Salt.*)

SULPHATE OF POTASH. (See *Aphthitalite.*)

SULPHATE OF SODA. (See *Glauber-Salt.*)

SULPHATE OF STRONTIAN. (See *Celestine.*)

SULPHATE OF ZINC. (See *White-Vitriol.*)

SULPHATO-CARBONATE OF LEAD. (See *Dyoxylite.*)

SULPHATO-TRI-CARBONATE OF LEAD. (See *Leadhillite.*)

SULPHO-SELENITE. Selenous Brittle-Sulphur.

Massive: in thin seams.

Color brown.

1. It is a sulphuret of selenium.

2. It occurs with Sal-Ammoniac in the crater of Volcano, one of the Lipari islands; and probably with Iron Pyrites at Fahlun, Sweden.

SULPHUR. Prismatic Brittle-Sulphur.

Primary form. Octahedron with rhombic base. P on P″ = 106° 20′.

Secondary forms.

Fig. 425.

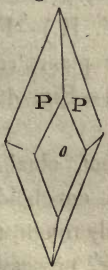


Fig. 426.

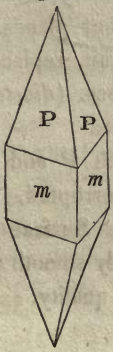


Fig. 427.

Fig. 428.

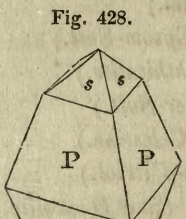
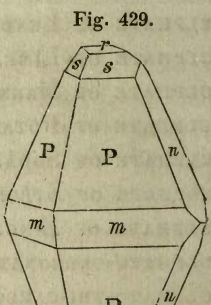


Fig. 429.



P on P	-	-	-	106°	38′
P on P over *n*	-	-	-	84	58
s on *s*	-	-	-	127	1
n on *n*	-	-	-	124	24
m on *m*	-	-	-	101	59
P on P over *m*	-	-	-	143	26
s on *r*	-	-	-	179	45

Fig. 425. Primary having the obtuse angles of the base truncated. (*unitaire.* Hauy.)—Fig. 426. Primary having the edges of the base replaced by tangent planes. (*prismé.* H.)—Fig. 427. Primary having the acute, pyramidal edges replaced by tangent planes. (*émoussé.* H.)—Fig. 428. Primary with summit, replaced by four planes resting upon the primary faces. (*dioctaèdre.* H.)—Fig. 429. (*equivalent.* H.)

Cleavage, parallel with P and *m* imperfect, obtained with difficulty, and interrupted. Fracture conchoidal, sometimes highly perfect. Surface *n* commonly rough, the rest of the faces generally smooth and shining, possessing nearly the same physical quality.

Sulphur.

Lustre resinous. Color, several shades of sulphur-yellow, inclining sometimes to red or green. Streak sulphur-yellow, passing into white. Transparent . . . translucent on the edges.

Sectile. Hardness = 1·5 . . . 2·5. Sp. gr. = 2·072.

Compound Varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel to a face of *r*. Imbedded globules: surface uneven; composition impalpable, often impure. Massive: composition granular, often impalpable, strongly coherent; fracture uneven, even, flat conchoidal. Sometimes pulverulent.

1. Sulphur as it occurs in nature is pure, or is only mixed with bitumen or clay. It acquires resinous electricity by friction, is easily inflammable, and burns with a blue or white flame, and a pungent smell of sulphurous acid. It is insoluble in water, but unites readily with potash or soda. It may be obtained crystallized by sublimation, or still more easily from solutions in liquids. The forms of sulphur, crystallized from fusion, are incompatible with those of the present species. They are generally oblique rhombic prisms of 90° 32′, the terminal face of which is inclined to the obtuse edge of the prism, which is itself commonly replaced at an angle of 95° 46′. It occurs almost always in regular compositions. The crystals are at first transparent, but they soon become opake.

2. Sulphur is generally met with in beds of Gypsum or in the accompanying strata of clay. It is generally associated with Calcareous Spar and with Celestine. It occurs in veins with Copper Pyrites, Galena, and Orpiment. It is deposited from several thermal springs and in large quantities from volcanos; sometimes it occurs in beds of Bituminous Coal.

3. Sulphur is found in splendid crystals and pure massive varieties, also, in globular concretions, (which however, are seldom without earthy or bituminous admixtures) in Sicily, and several provinces of Italy. It occurs in imbedded spheroidal masses of a brown color, which is owing to bitumen at Radoboy, near Crapina in Croatia. Near Cracovia in Poland, it is likewise met with more or less in pure massive varieties and small crystals. The finest crystals, excepting those from Sicily,

come from Cadiz in Spain. Small crystals have been observed investing the brown coal from Artern in Thuringia. It occurs in veins in Swabia, in Spain and in Transylvania. The earthy Sulphur is found in Poland, in Moravia, and other countries; the volcanic Sulphur in Iceland, near Vesuvius, in Milo and several islands of the Grecian Archipelago; in great profusion near the volcanos of Java and the Sandwich islands. Sulphur also occurs in Savoy, in Piedmont, in Switzerland, at Lauenstein in Hanover, in South America, and many other countries.

4. It requires to be purified, either by melting or by sublimation, in order to be employed in the arts. It is used in the manufacture of gunpowder, of cinnabar, sulphuric acid, and of several pharmaceutical preparations.

SULPHUREOUS ACID. Aeriform Sulphurous-Acid. Mohs.

Gaseous. Transparent.

Sp. gr. = 2·2553. Thenard and Gay-Lussac.
= 2·2295. Davy.

Odor pungent. Taste acid.

1. According to Berzelius, Sulphurous-Acid Gas is composed of

Sulphur	50·144
Oxygen	49·856

It is fatal to life, and extinguishes combustion. It reddens, and finally destroys vegetable blues. It becomes liquid at a temperature of 0° Fahr., or under a pressure equal to two atmospheres. Water, at 61° Fahr., absorbs 33 times its bulk of this gas, or nearly one eleventh of its weight.

2. It is evolved in great quantities from the waters of active volcanos, as those of Etna and Mount Vesuvius, and those of the Sandwich Islands. When emitted along with sulphuretted hydrogen, a mutual decomposition results, and incrustations of sulphur are formed, as in the volcano of Puracé, near Popayan. It occurs likewise, along with carbonic acid, in a cave which is situated in the Büdös hegy, a porphyry hill in Transylvania, on the frontiers of Moldavia.

3. Sulphurous-Acid Gas, artificially generated by the combustion of sulphur in common air, is used in bleaching silks; likewise, for discharging vegetable stains and iron-moulds from linen.

Sulphuretted Hydrogen.

SULPHURET OF ANTIMONY. (See *Grey Antimony.*)
SULPHURET OF BISMUTH. (See *Bismuthine.*)
SULPHURET OF COBALT. (See *Cobalt Pyrites.*)
SULPHURET OF COPPER. (See *Vitreous Copper.*)
SULPHURET OF LEAD. (See *Galena.*)
SULPHURET OF MANGANESE. (See *Manganblende.*)
SULPHURET OF MERCURY. (See *Cinnabar.*)
SULPHURET OF MOLYBDENA. (See *Molybdenite.*)
SULPHURET OF SILVER. (See *Vitreous Silver.*)
SULPHURET OF TIN. (See *Tin Pyrites.*)
SULPHURET OF ZINC. (See *Blende.*)

SULPHURETTED HYDROGEN. Sulphureous Hydrogen-Gas. Mohs.

Amorphous. Transparent. Expansible.

Sp. gr.=1·181.

Odor of putrid eggs.

1. It does not support combustion; it blackens most of the metals, and becomes fatal to animals, if inhaled in any considerable quantity.

2. *Analysis.*

By BERZELIUS.

Hydrogen	5·824
Sulphur	94·176

3. It is developed from sulphureous waters, both cold and warm, as at Neundorf in Westphalia, and at Baaden near Vienna; also from swamps and marshes. In Italy, it is disengaged from the soil of the *Solfataras*, and of the *Fumacchio*, sometimes mixed with other kinds of gas.

In the U. States, it has been observed at numerous springs throughout New York, Ohio, and other western states. On the western bank of Niagara river, a mile south of the Falls, it issues from a bank, which consists of a shelly limestone, including thin beds of coal and Iron Pyrites; under similar circumstances also at Otsquaga creek. It abounds particularly in the boiling springs of Florida.

SULPHURIC ACID. Liquid Sulphuric-Acid. Mohs.

Liquid. Transparent, in different degrees.

Sp. gr. = 1·846 Ure, when pure, but varies to a little above 1·0 according to its dilution. Taste strongly acid and caustic.

1. The anhydrous sulphuric acid is solid, and, according to Berzelius, consists of

Sulphur	40·14
Oxygen	59·86

This is obtained from the first portions which come over from the distillation of fuming sulphuric acid; the fumes concrete upon the sides of the receiver in tough, silky filaments, which are entirely free from water. The strong, liquid sulphuric acid, contains at least 18·5 p. c. of water. When it is diluted to a sp. gr. of 1·780, it crystallizes at 45° F.; when of a sp. gr. between 1·786 and 1·775 at 32°, and when it is as high as 1·843, at —15°. The crystals have the figure of six-sided prisms terminated by six-sided pyramids. Common sulphuric acid is an oily looking fluid, limpid and inodorous, and eminently destructive of animal and vegetable bodies. It rapidly absorbs moisture from the air, and evolves heat when mingled with water in every proportion.

2. It is produced in many places from the decomposition of water and Iron Pyrites. A remarkable locality of it, called the *sour spring*, exists in Byron, Genesee co. (N. Y.) near the Erie canal. The acid is produced from a hillock 230 feet long and 100 broad, elevated about five feet above the surrounding plane. It contains an abundance of Iron-Pyrites in exceedingly minute grains; and is covered with a coat of charred vegetable matter to the depth of four or five inches, occasioned by the action of the sulphuric acid. Wherever holes have been sunk in this hill, the acid accumulates; also in the depressions in the contiguous meadow ground. When the season is dry, it collects in a perfectly concentrated state. This acid, similarly produced, occurs in a cavern near Sienna in Tuscany, and at Aix in Savoy. A considerable lake of it exists in the ancient crater of Mount Idienne in Java; and a stream of it, called the Rio de Vinegro, flows from the extinct volcano Puracé near Popayan, whose waters are fatal to fish, and the spray arising from them irritating to the eyes of animals.

3. Sulphuric acid, or *oil of vitriol*, which is artificially produced from the combustion of sulphur in contact with a little nitre, is of very extensive use in chemistry, as well as in metallurgy, bleaching and some of the processes for dyeing; it is also employed in the formation of numerous salts, as copperas, sulphate of magnesia, &c., and is administered in medicine as a tonic and stimulant, and sometimes used externally as a caustic.

SYLVITE.

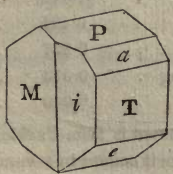
Soluble with the taste of Common Salt, and crystallizable from solution in cubes, parallel to whose faces it cleaves. The aqueous solution affords a yellow precipitate on the addition of muriate of platina. Treated with sulphuric acid, it leaves after evaporation acicular crystals, which do not effloresce in the air. It is supposed to be muriate of potash; and is found in small quantity, mingled with Common Salt, in the mines of Hallein, and of Berchtesgaden.

TABULAR-SPAR. Tetarto-prismatic Tabular-Spar.

Primary form. Doubly oblique prism. P on T = 126°? P on M = 93° 40′. M on T = 95° 15′.

Secondary form.

Fig. 430.



M on *i*	- -	139°	48′	PHILLIPS.
T on *i*	- -	135	30	"
P on *a*	- -	156	30	"
P on *e*	- -	94	15	"

Cleavage, in the direction of M and T easily obtained, but one of them more perfect than the other; parallel with P indistinct. Fracture uneven.

Tabular-Spar.

Lustre vitreous, inclining to pearly upon M and T. Color white, inclining to grey, yellow, red and brown. Streak white. Semi-transparent... translucent.

Rather brittle. Hardness = 4·0...5·0. Sp. gr. = 2·805.

Compound Varieties. Long individuals produce a rereticulated composition; the composition apparently taking place parallel with a plane in the direction of *a*, and inclining to T under about 140°. (Grenville, Lower Canada.) Massive: composition lamellar, generally longish, and aggregated into a second large grained and angular composition. Strongly coherent.

1. Before the blow-pipe, it melts on the edges into a semi-transparent colorless enamel. It requires a strong heat for melting, and sometimes boils a little. It is easily dissolved by borax, forming with it a transparent globule. By fusing lime and silica in the required proportions, cleavable masses of the present species have been obtained.

2. *Analysis.*

	By Stromeyer.	By Rose.
Silica	51·455	51·60
Lime	47·412	46·41
Protoxide of iron	0·401	a trace.
Oxide of manganese	0·257	0·00
Water and loss by heating	0 076	0 00
Mechanical admixtures	0·000	1·11

3. The oldest variety known is from Czcklowa near Orawitza, in the Bannat of Temeswar, where it occurs in several copper mines. In Finland, it occurs in limestone; at Edinburgh, in the greenstone of Castle-hill. The variety called *Wollastonite*, from Capo di Bove near Rome, occurs in lava, resembling basalt. A very handsome greenish white variety, in large individuals, occurs in limestone bowlders at Grenville in Lower Canada.

In the United States are two localities; one at Willsborough, (N.Y.) where the mineral forms the sides of a powerful vein of Garnet, which traverses a mountain of gneiss: the other is at Easton in Pennsylvania, where it exists in limestone.

TACHYLITE. (See *Pitchstone.*)

TALC. Prismatic Talc-Mica. MOHS.

Primary form. Right rhombic prism. M on M=120° nearly.

Secondary form. Primary, having its acute lateral edges replaced by tangent planes.

Cleavage, parallel with P, commonly very perfect. Fracture not observable. Surface, P smooth, the other planes striated horizontally.

Lustre pearly upon P, both as faces of crystallization and cleavage. The other faces possess vitreous lustre, inclining to adamantine, generally low degrees.

Color various shades of green, as blackish green, leek green, celandine-green, and apple-green, passing into greenish grey, greenish white and greyish white. Streak corresponding to the color, green ... white. Semi-transparent ... translucent. Different colors in different directions. Some individuals are of a bright green color if viewed in a direction perpendicular to the laminæ, while parallel to them they exhibit a fine brown tinge. In the latter direction they are much more transparent than in the former.

Sectile, in a high degree. Thin laminæ are easily flexible. Hardness=1·0 ... 1·5. Sp. gr. = 2·713, a dark green variety.

Compound Varieties. Imperfect globules and stellular groupes: composition imperfectly columnar. Sometimes several crystals are engaged with each other, so as to produce conical and cylindrical aggregations. Massive: composition granular, of various sizes of individuals, often impalpable; sometimes imperfectly columnar. The individu-

als are sometimes strongly coherent with each other or flat, so as to give rise to an imperfectly slaty structure. Often earthy, without connexion of its particles.

1. The differences among the varieties comprehended within the present species, depend upon various properties of the individuals themselves, upon diversities in their composition, and the presence of foreign matter. The varieties of dark green (leek-green, celandine green, &c.) colors, inclining to brown, constitute the *chlorite*, subdivided into *foliated* and *common*, *slaty* and *earthy* chlorite. The first of these contains the crystallized varieties, and such compound ones as consist of easily separable individuals, not presenting a slaty structure. The second contains those granularly compound varieties in which the individuals can scarcely be traced, or in which they are not observable at all. Chlorite-slate, or slaty-chlorite, refers to such compound varieties as have a slaty texture; and earthy-chlorite to such as are but loosely coherent, or already in a state of loose scaly particles. Immediately with those varieties of Chlorite whose composition is impalpable, the *Green Earth* is connected; from which, however, must be excepted what has been termed crystallized Green Earth, and which, consists of decomposed crystals of Pyroxene. Common Talc embraces crystallized varieties, and such compound ones in which cleavage is transformed into slaty structure, the latter being generally very perfect; or such as consist of columnar particles of composition. Earthy Talc, or *Nacrite*, consists of loose particles, or such as are but slightly cohering; *Indurated Talc* refers to imperfect and coarse slaty varieties, in which this kind of structure is more the consequence of composition than of imperfect cleavage. If this structure be sufficiently imperfect to become coarse, and indistinctly granular, *Pot-stone*, or *Lapis ollaris* is formed, which possessing the united properties of softness and tenacity, may be easily turned into vessels; for which reason only it appears to have been regarded as a distinct species. Closely connected with this variety, is the Steatite, which often occurs in coatings and pseudomorphoses, and the soapstone, which is white, or mottled red and green.

2. Before the blow pipe, Talc offers, according to its color and foreign admixtures, various appearances. In general it loses its color, and is with difficulty fused, or changed into a black scoria, or is altogether infusible.

Talc.

3. *Analysis.*

Analysts.	Varieties.	Silica.	Magnesia.	Alumina.	Iron.	Potash.	Lime.	Water.	Total.
Vauquelin.	Foliated,	62·000	27·000	1·500	Ox. 3·500	0·000	0·000	6·000	100·000
	Green Earth,	52·000	6·000	7·000	" 23·000	7·500	0·000	4·000	99·500
	Nacrite,	50·000	0·000	26·000	" 5·000	17·500	1·500	0·000	100·000
	Chlorite,	26·000	8·000	18·500	" 43·000	2·000	0·000	2·000	99·500
Gruner.	Chlorite Slate,	29·500	21·390	15·620	" 23·390	0·000	1·500	7·380	98·780
Klaproth.	Foliated,	62·000	30·500	0·000	" 2·500	2·750	0·000	0·000	97·750
Lampadius.	Slaty Chlorite,	35·000	29·900	18·000	" 9·700	0·000	0·000	2·700	95·300
Klaproth.	Soapstone of Cornwall,	45·000	24·750	9·250	" 1 000	0·000	0·000	18·000	98·000
	Steatite of Bayreuth,	59·500	30·500	0·000	" 2·500	0·000	0·000	5·500	98·000
Wieglib.	Potstone,	38·000	35·000	7·000	" 15·000	0·000	0·000	0·000	97·000
Thomson.	Chlorite, from Isle of Bute,	27·624	10·960	23·708	Prot. 27·544	0·000	0·000	9·160	98·996
	Chlorite Earth, fr. Highlands of Scotland,	48·166	2·916	16·851	Per. 19·000	6·558	2·675	2·350	98·718
	Venetian Talc,	62·588	30·328	0·000	Prot. 3·848	0·000	0·000	3·400	99·964
	Talcose Slate, from Piedmont,	57·560	27·216	1·720	" 4·716	0·000	7·944	1·600	100·756
	Potstone, from Sweden,	49·010	30·200	6·080	" 11·400	0·000	0·000	4·200	100·890
	Common Talc,	29·364	12·144	17·808	" 26·616	0·000	3·092	11·200	100·234
	Indurated Talc, from Sweden,	39·524	35·080	6·200	" 11·528	0·000	0·000	8·120	100·452
	Cornish Talc, or *Gilbertite*,	45·155	1·900	40·110	" 2·430	0·000	4·170	4·250	98·015
	Soapstone of Cornwall, red,	42·320	25·680	9·384	" 1·083	0·000	4·680	16·960	100·107
	Soapstone of Cornwall, white,	43·884	24·144	9·872	0·000	0·000	0·000	21·228	99·128

Talc.

4. Common Talc, indurated Talc, Potstone and slaty Chlorite, constitute beds in primitive mountains. The latter frequently contains imbedded crystals of Magnetic Iron; some of the former contain Apatite and Rhomb Spar. Common Chlorite in particular, is found in beds in primitive rocks, consisting chiefly of limestone, Hornblende and Magnetic Iron. Soapstone is found in veins in serpentine, and Steatite, in beds in chlorite slate and in serpentine. The latter often contains the variety of Dolomite called Bitter Spar. Other varieties, and among them the small scaly crystals of foliated Chlorite, occur in veins of various descriptions, and in the crystal caves of the Alps. Green-Earth, and sometimes also foliated Chlorite, occur in amygdaloidal rocks, where they are found either lining the vesicular cavities, or as imbedded nodules in the body of the rock itself. Earthy Talc, or Nacrite, has been found in lead veins.

5. Those varieties which by themselves form mountain masses, are met with in the primitive districts of the Tyrol, Salzburg, Switzerland, Sweden, Norway, Corsica, &c.; in the Grampians in Scotland; in Unst, one of the Shetland isles. Upon beds and veins with metallic ores, &c., they occur in considerable quantity in Cornwall; also in Saxony, Salzburg, and Sweden, &c. The crystallized varieties occur in veins, frequently in Mount St. Gothard, Salzburg and other countries. The chief localities of the green-earth are the Monte Baldo near Verona, Iceland, the Faroe Islands, Tyrol, Hungary and Transylvania.

The United States abound in the present species. Soapstone and Steatite form powerful beds and veins in the western parts of Massachusetts, in New Hampshire, Vermont, and in Rhode Island. At Marlborough, (Vt.) it embraces very perfect crystals of the Rhomb Spar. The same mineral is found in the Steatite of North Providence, (R. I.), but not in distinct crystals. Crystallized varieties are of rare occurrence, except in globular forms, and then in small quantities. Beautiful columnar specimens, of a delicate green color, occur at Smithfield, (R. I.) in Steatite; and white granular varieties at Smithfield, in limestone, in the same vicinity. A handsome green Talc is found at Bridgewater in the talcose slate region, with which is intermingled a transparent massive Dolomite. Chlorite abounds throughout New England, and the chlorite slate formation is traceable from Vermont to Georgia.

6. Some of the varieties of Talc, as Soapstone and Steatite, are used as fire stones in iron-furnaces, in stoves for heating houses, and in culinary vessels. Green earth is used, both raw as a green color, and burnt as a reddish-brown color, for painting houses, &c. The Venetian Talc

REESE LIBRARY OF THE UNIVERSITY OF CALIFORNIA

vas formerly used in medicine, and is now employed in removing oil-tains from woollen cloth.

Tantalite. (See *Columbite.*)

Tautolite.

Primary form. Right rhombic prism. M on M = 109° 46′.

Secondary form. The primary, having the acute angles, and the acute lateral edges truncated; the former so deeply as to produce a dihedral summit of 51° 52′. The acute lateral edges are also bevelled, the bevelling planes meeting at an angle of 86° 22′.

Cleavage, only in traces, and interrupted parallel to M. Fracture conchoidal . . . uneven.

Lustre vitreous. Color velvet-black. Streak grey. Opake.

Hardness = 6 5 . . . 7·0. Sp. gr. = 3·865.

1. Before the blow-pipe, on charcoal, it melts to a blackish scoria, which is attracted by the magnet; with borax, it melts to a clear green glass. Hence it may be presumed to consist of silica, protoxide of iron, magnesia and alumina.

2. It is found in the volcanic rocks in the neighborhood of Lake Laach in Prussia.

3. It is closely related to Peridot.

Telluric Bismuth. (See *Bornine.*)

Telluric Lead.

Massive.

Cleavages in three directions, apparently leading to the cube.

Lustre shining. Color, tin-white.

Hardness = 3·0. Sp. gr. = 8·159.

1. It colors the flame of the blow-pipe blue. It melts, and is at length reduced to a little button of silver, surrounded by a sublimate of telluret of lead, and a yellowish brown deposit.

2. *Analysis.*

By Rose.

Lead	60·36
Silver	1·28
Tellurium	38·37

3. It is found with Blende, Iron Pyrites and Telluric Silver, at the mine of Sawodinski in Siberia.

4. It approaches in its properties the Black Tellurium.

TELLURIC SILVER. Telluric Polypoione-Glance.

Massive. Cleavage, in one direction distinct.

Lustre shining. Color between lead grey and steel grey.

Hardness = 2·5 ... 2·75. Sp. gr. = 8·412.

1. Before the blow-pipe, it melts upon charcoal into a black mass, in which dendrites of silver are visible. It is soluble in cold nitric acid.

2. *Analysis.*

By Rose.

Silver	82·63
Tellurium	37 37

3. It is found with Iron Pyrites, Blende and Telluric Lead, in the mine of Sawodinski, in Siberia.

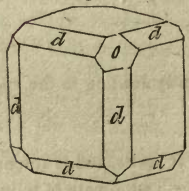
Tennantite.

Primary form. Tetrahedron.

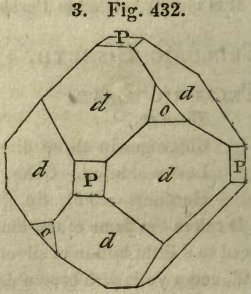
Secondary forms.

1. Tetrahedron, with angles truncated.

2. Fig. 431.



3. Fig. 432.



Cleavage, parallel with *d*, imperfect.

Lustre metallic. Color blackish lead-grey. Streak reddish grey. Opake.

Brittle. Scratches Fahlerz. Sp. gr. = 4·375 ... 4·491.

Compound Varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel to a face of the octahedron; the individuals are continued beyond the face of composi-

Tephroite.

tion.* Massive, composition granular ... impalpable. Fracture uneven.

1. Before the blow-pipe, it decrepitates a little, and burns with a blue flame, emitting copious arsenical vapors, and melting at last into a black scoria, which affects the magnetic needle.

2. *Analysis.*

By R. PHILLIPS.

Copper	45·32
Arsenic	11·84
Iron	9·26
Sulphur	28·74
Silica	5·00

3. It occurs in several of the Cornish copper mines, in veins traversing granite and clay-slate; and is accompanied by several ores of copper.

4. It is probable that Tennantite, which was formerly included under Fahlerz, will prove to be a distinct species. Its inferior specific gravity, and greater hardness, are favorable to this idea.

TEPHROITE.

Massive: composition granular, of various sizes of individuals. Cleavage, parallel with the sides of a prism, but indistinct; with the faces of an octahedron, only in traces. Fracture even to subconchoidal.

Lustre adamantine. Color ash-grey, dark liver-brown to black. Streak pale ash-grey.

Hardness = 5·00. Sp. gr. = 4·104 ... 4·116.

1. Fusible before the blow-pipe into a black scoria.

2. Its locality is given as Sparta, (N.J.) where it is said to occur along with Franklinite.

3. It appears to be a variety of Troostite.

TESSELITE. (See *Apophyllite.*)

TESSERAL-PYRITES.

Massive. Cleavage, parallel with the faces of a cube, distinct; with the faces of the dodecahedron only in traces.

* The existence of the regular composition is most easily ascertained by the striæ upon the faces of the cube, which are parallel to the edges of combination with one of the tetrahedrons.

Color tin-white.

Hardness (scale of BREITHAUPT) = 7·25 . . . 7·75. Sp. gr. = 6·74 . . . 6·84.

1. It occurs at Skutterud in Norway.

TETARTIN. (See *Albite.*)

TETRADYMITE.

Primary form. Rhomboid. P on P = 81° 2′.

Cleavage, perfect at right angles to the axis.

Color lead-grey.

In thin laminæ, somewhat flexible. Hardness = 1·50 . . . 2·0 Sp. gr. = 7·460 . . . 7·514.

Compound Varieties. Twin-crystals.

THENARDITE. Peritomous Brythine-Salt.

Primary form. Right rhombic prism. M on M = 125°.

Secondary form.

1. The primary, having the terminal edges deeply replaced; sometimes producing an octahedron with a rhombic base.

Cleavage, perfect parallel with the faces of the primary form; most distinct parallel with P.

Lustre vitreous. Color white. Transparent. After exposure to the light, it becomes coated with a white powder.

Sp. gr. = 2·73.

1. It is wholly soluble in water.

2. *Analysis.*

By CORDIER.

Sulphate of soda	99·78
Sub-carbonate of soda	0·22

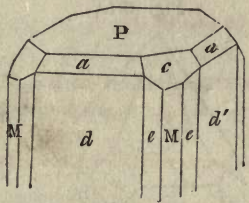
3. It occurs five leagues from Madrid, and two and a half leagues from Aranjues in Spain, at a place called Salines d'Espartines. It is deposited by evaporation, every summer, from a lake which holds it in solution.

THOMSONITE. Orthotomous Kouphone-Spar.

Primary form. Right square prism.

Secondary form.

Fig. 433.



M on *d*	- - - -	135° 00′
P on *a*	- - - -	134 38
P on *c*	- - - -	125 00

Cleavage, perfect parallel with M, with P only in traces. Fracture uneven. Surface smooth.

Lustre vitreous, much inclining to pearly. Color white. Transparent . . . translucent.

Brittle. Hardness=5·0. Sp. gr.=2·37.

Compound Varieties. Massive: composition columnar, radiating from common centres.

1. It intumesces before the blow-pipe, and becomes snow-white and opake, but does not melt.

2. *Analysis.*

	By Thomson.	By Berzelius.
Silica	38·80	38·30
Alumina	31·36	30·20
Lime	15·40	13·54
Soda	0·00	4·53
Magnesia	0·20	0·40
Peroxide of iron	0·60	0·00
Water	13·00	13·10

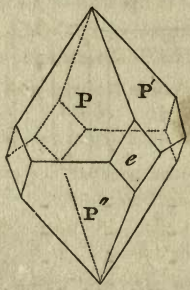
3. It is found with Analcime in the trap rocks of Kilpatrick, near Dumbarton in Scotland.

THORITE. Peritomous Tungstic-Baryte.

Primary form. Octahedron with a square base? P on P=120′.

Secondary form.

Fig. 434.



Cleavage, parallel with *e*, imperfect. Fracture uneven and splintery.

Lustre resinous. Color brown. Streak yellowish grey to brown.

Hardness=5·0 . . . 5·50. Sp. gr.=4·5 . . . 4·6.

1. Alone, before the blow-pipe, it is infusible, but becomes paler. It melts slowly with borax into a colorless glass.

2. *Analysis.*

Thorina	57·41
Lime	2·58
Oxide of iron	3·40
Oxide of manganese	2·39
Magnesia	0·36
Oxide of uranium	1·61
Oxide of lead	0·80
Oxide of tin	0·01
Silica	18·98
Water	9·50
Potash	0·14
Soda	0·10
Alumina	0·06
Powder not examined	1·70

Tin-Ore.

It was found in sienite, in the isle of Lövön, near Brevig in Norway; but is now no longer to be obtained.

THRAULITE. (See *Hisingerite.*)

THULITE.

Cleavage, parallel to the sides of a rhombic prism, of 92° 30′.

Color rose-red. Streak greyish white.

Scratched by Quartz, and yielding to the knife with difficulty.

1. It occurs at Tellemarken in Norway with Quartz, Fluor and Idocrase.

THURINGITE.

Massive: composition lamellar, and granular.

Cleavage, in one direction perfect.

Lustre pearly. Color olive-green. Streak siskin-green, and shining with a resinous lustre.

Greasy to the feel. Hardness (scale of BREITHAUPT) = 2·5 ... 3·0. Sp. gr. = 3·151 ... 3·157.

1. Found at Schmiedefeld in Saalfeld.

TILE-ORE. (See *Red Copper-Ore.*)

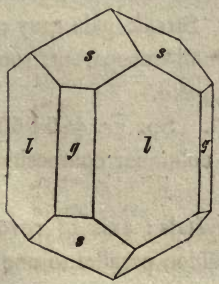
TINDER-ORE. (See *Red Antimony.*)

TIN-ORE. Peritomous Baryte-Ore.

Primary form. Octahedron with a square base. P on P″ = 67° 50′. P on P′ = 133° 30′.

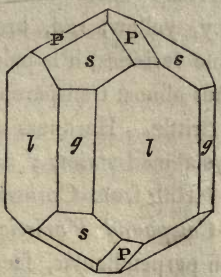
Secondary forms.

Fig. 435.



Cornwall.

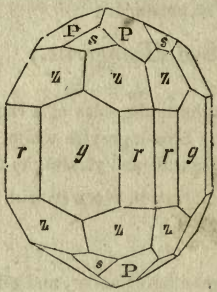
Fig. 436.



Goshen, (Mass.)

Tin-Ore.

Fig. 437.



Cornwall.

s on *s*	-	-	-	121° 35′
s on *s* over *g*	-	-	-	87 17
z on *z*	-	-	159° 6′ and	118 16
z on *z* over *r*	-	-	-	135 17
r on *r*	-	-	112° 27′ and	157 23

Cleavage, *s* and *g* not very distinct, traces of P. Fracture imperfectly conchoidal, uneven.

Surface, *g* often uneven, *s* sometimes irregularly striated parallel to the edges of combination with P, and the latter pyramid parallel to those with *s*. The prisms are sometimes vertically streaked.

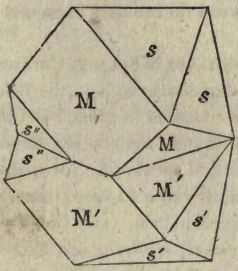
Lustre adamantine. Color various shades of white, grey, yellow, red, brown, black. Streak pale grey; in some varieties, it is pale brown. Semi-transparent, sometimes almost transparent... nearly opake.

Brittle. Hardness = 6·0...7·0. Sp. gr. = 6·960, a crystallized variety; =6·514, thin columnar composition; =7·100, from Cornwall.

Compound Varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel to one of the faces of P.

Tin-Ore.

Fig. 438.



Small reniform, rarely botryoidal shapes: composition very thin columnar, divergent from common centres, strongly connected, and often forming a second curved lamellar composition. Massive: composition granular, sometimes almost impalpable, strongly connected, fracture uneven. The hardness of very thin columnar compositions is often found as low as 5·5, owing to the delicacy of the individuals in this composition.

1. The *Wood-Tin* of the Cornish miners is only a variety of Tin-Ore, in the same manner as Red Hematite is of Specular Iron.

2. When heated in the platina forceps before the blow-pipe, it is unalterable. Upon charcoal, in a strong heat, it is reduced to the metallic state. The reduction is promoted by the addition of carbonate of soda. It is not attacked by acids. Fused with caustic potash, it yields a mass, which is mostly soluble in water. Muriatic acid, added to the solution, occasions a white precipitate, which is again dissolved. Hydriodic acid produces a yellow precipitate.

3. *Analysis.*

	By Klaproth. Crystallized var.	By Descotils. Compound var.
Oxide of tin	99·00	95·00
Oxide of iron	0·25	5·00
Silica	0·75	0·00

4. Tin-Ore occurs disseminated in rocks, particularly in granite; also in beds and veins. It is frequently accompanied by Wolfram and Molyb-

denite. It occurs in pebbles and is extracted, in this shape from stream-works. The variety wood-tin has only been met with in these repositories.

5. Its principal deposits are in Saxony, Cornwall and Bohemia. It is found in considerable abundance, both on the Bohemian and Saxon sides of the Erzgebirge, disseminated in granite and in beds alternating with it; particular localities in this region, are Schlaggenwald, Altenberg, Gezer, Ehrenfriedersdorf, Marienberg. Twin-crystals abound at Schlaggenwald. In Cornwall, it exists in veins traversing granite and schist, and is accompanied by green Talc, (var. Chlorite,) Fluor, Quartz, Topaz, Tourmaline, Mispickel, Wolfram and Blende. At St. Michael's Mount, it is disseminated through granite. The ore is chiefly in the state of single crystals. Stream-works exist both in Cornwall and Saxony. It is found in Galicia, Spain, in mica-slate, in the granite hill of Puy des Vignes, Haute Vienne, in France, and in the mountain chains of Fichtel and Riesengebürge in Germany. Other localities are in Asia, on the east coast of Sumatra, Siam and Pegu; also at Banca and Malacca, and in Mexico and Chili. A few black crystals have been found with Tourmaline in Albite, at Goshen, (Mass.)

TIN-PYRITES. Hexahedral Copper-Glance.

Primary form. Cube.

Massive: composition granular, strongly coherent. Fracture uneven, imperfectly conchoidal.

Lustre metallic. Color steel-grey, inclining to yellow. Streak black. Opake.

Brittle. Hardness = 4·0. Sp. gr. = 4·479 . . . 4·515.

1. Heated in an open tube, it gives the smell of sulphurous acid. On charcoal before the blow-pipe, it melts, depositing at the same time a white powder, which is not volatile and consists of oxide of tin, a brittle globule remaining behind. On moistening the mass with muriatic acid, and exposing it to the flame of a lamp, it colors it of a beautiful blue. The mineral being treated with fluxes, gives the reactions of copper and iron. It is soluble in nitro-muriatic acid, during which the sulphur is precipitated. 2. *Analysis.*

By KLAPROTH.

Sulphur	20·85		35·00
Tin	38·11		34 00
Copper	41 04		39·00
Iron	0·00		2·00

3. It is found near St. Agnes in Cornwall, and at Zinnwald in Saxony.

TITANITE. (See *Sphene.*)

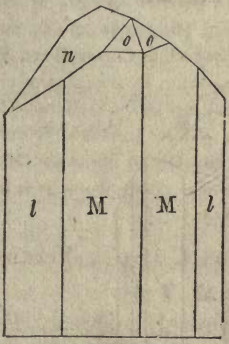
TITANITIC IRON. (See *Crichtonite.*)

TOPAZ. Prismatic Topaz. MOHS.

Primary form. Right rhombic prism. M on M = 124° 19′.

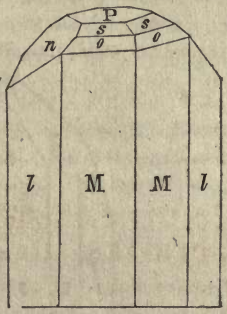
Secondary forms.

Fig. 439.



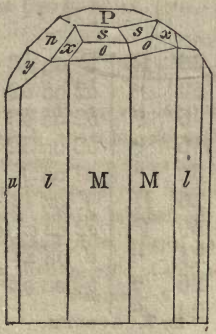
Trumbull, (Conn.)

Fig. 440.



Trumbull, (Conn.)

Fig. 441.

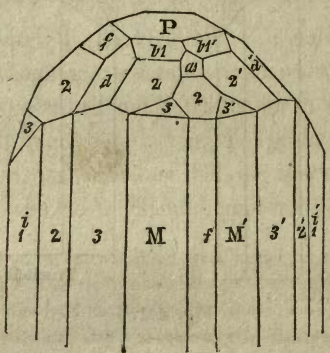


Trumbull, (Conn.)

Topaz.

M on *l*	- -	161° 16′	Hauy.
M on *o*	- -	135 59	"
l on *l*	- -	93 6	"
M on *u*	- -	150 6	"
n on *n*	- -	91 58	"
o on *o*	- -	140 46	"
o on *s*	- -	168 37	"
P on *o*	- -	134 1	"
P on *n*	- -	135 59	"
P on *x*	- -	138 26	"
P on *u*	- -	117 21	"

Fig. 442.



P on *b*1	-	124° 36′	P.
P on *b*2	-	135 59	"
M on *i*1	-	150 6	"
M on *i*2	-	161 16	"
M on *i*3	-	169 34	"
P on *c*1	-	128 26	H.
P on *c*2	-	135 59	P.
P on *c*3	-	117 21	"
P on *d*	-	138 26	"
P on *b*1	-	145 24	"

P on *b*2	-	134° 1′	P.
*b*2 on *b*2	-	140 46	"
*b*2 on *b*3	-	162 00	"
*b*3 on *i*2	-	148 22	"
*a*1 on *f*	-	134 00	"
f on *i*2	-	122 17	H.
*c*2 on *c*2, over P		92 45	P.
d on *i*2	-	131 34	H.
*b*3 on *a*2	-	155 30	P.

Topaz.

Cleavage; parallel with P highly perfect; with *n* imperfect; traces of M and *l*. Fracture more or less perfectly small conchoidal, uneven. Surface, P rough, sometimes faintly striated, parallel to the edges of combination with *l*. The vertical planes always striated, sometimes deeply, parallel to their common edges of combination. The pyramidal planes always smooth.

Lustre vitreous. Color, white, yellow, green, blue, various, but generally pale shades. Streak white. Transparent . . . translucent, sometimes only on the edges.

Hardness = 8·0. Sp. gr. = 3·499, of a transparent crystallized variety; = 3·494 variety Pycnite.

Compound Varieties. Massive: composition granular, of various sizes of individuals; faces of composition rough. There occurs also columnar composition, the individuals being thin, long and parallel, and easily separated, and their faces of composition longitudinally streaked.

1. Two varieties of Topaz have been treated of by many writers as distinct species: viz. the *Physalite* and *Pycnite*. The first of these consists of imbedded crystals, whose surface is rough and uneven, or large massive individuals, whose color is a pale greenish grey. The latter occurs in thin and straight columnar particles of composition, forming larger or smaller imbedded masses, and not possessing bright colors or high degrees of transparency.

2. In a strong heat, the faces of crystallization, but not those of cleavage, are covered with small blisters, which however, immediately crack. With borax, it melts slowly into a transparent glass. Its powder colors the tincture of violets green. Those crystals which possess different faces of crystallization on opposite ends, acquire different kinds of electricity on being heated. By friction, it acquires positive electricity.

Topaz.

3. *Analysis.*

By Berzelius.

	Crystals.	Physalite.	Pycnite.
Alumina	57·45	57·74	51·00
Silica	34·24	34·36	38·43
Fluoric acid	7·75	7·77	8·84

4. Topaz enters into the composition of granitic rocks; thus it forms with Quartz and Tourmaline the Topaz-rock of Saxony. It occurs also in irregular beds, either with Quartz and Mica, like the variety Pycnite; or with Feldspar, Quartz, Beryl, &c. like the Physalite. It is also found in veins, traversing gneiss, where it is associated with Fluor, Mica and Wolfram, as at Trumbull, (Conn.) It is met with besides in tin stream-works, and in the alluvial deposits of rivers along with other gems.

5. The most perfect crystals are found with Beryl in the Uralian and Altai mountains, and in Kamtschatka; in Brazil, where they are met with in loose crystals, and at Mucla in Asia Minor. They occur in the Topaz-rock at Danneberb in Saxony, and at Ehrenfriedersdorf and Zinnwald associated with Tin-ore; in similar repositories at Schlaggenwald in Bohemia and St. Michaels mount in Cornwall; with Lepedolite near Rozena in Moravia. Physalite is found at Finbo and Broddbo near Fahlun in Sweden. Pycnite at Altenberg in Saxony. Topaz pebbles are found in the stream-works of Eubenstock in Saxony, in the granitic districts of Cairngorm in Aberdeenshire, and in New South Wales.

But a single locality is known in the United States, which exists at Trumbull, (Conn.) in a vein upwards of one foot in width, where it is associated with Fluor, Magnetic Pyrites, Mica, and rarely with Wolfram and Tungsten. The Topaz is chiefly white, but when imbedded in the magnetic Pyrites its color is green. It presents small druses occuring in the veins, lined with tolerably perfect crystals, which are white and transparent. Occasionally the crystals are several inches in diameter, and perfect in some of their planes, but they are generally deficient in transparency and lustre. Rarely, the massive individuals and imperfect crystals are six or eight inches in diameter.

6. It is much used as an ornamental stone. The blue varieties are called *Oriental Aquamarine*, by Lapidaries. If exposed to heat, the Topaz from Saxony loses its color and becomes white; the deep yellow Brazilian varieties assume a pale pink color, and are then sometimes mistaken for Spinel, or Ballas-ruby.

Tourmaline.

TOPAZOLITE. (See *Garnet.*)

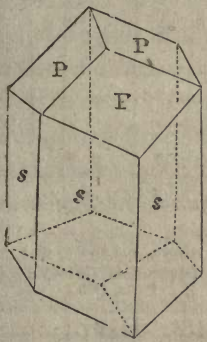
TORRELITE. (See *Quartz.*)

TOURMALINE. Rhombohedral Tourmaline.

Primary form. Rhomboid. P on P=133° 26′.

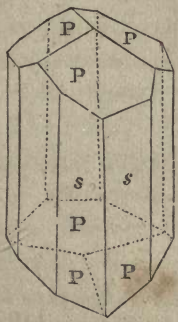
Secondary forms.

Fig. 443.



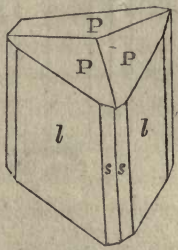
(Brown.)
Monroe, (Conn.)

Fig. 444.



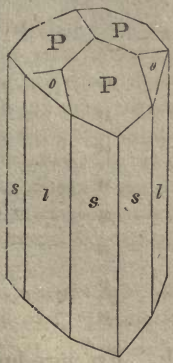
(Brown.)
Monroe, (Conn.)

Fig. 445.



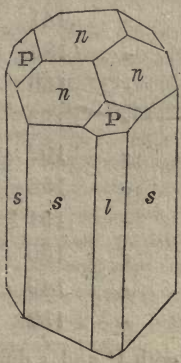
(Black.)
Haddam, (Conn.)

Fig. 446.



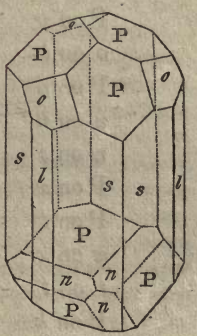
(Black.)
Brunswick, (Me.)

Fig. 447.



(Black.)
Brunswick, (Me.)—
Monroe, (Conn.)

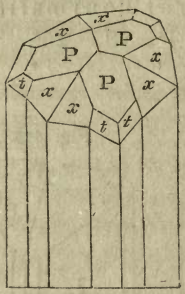
Fig. 448.



(Cinnamon-red.)
Newton, (N. J.)—Gouverneur, (N. Y.)

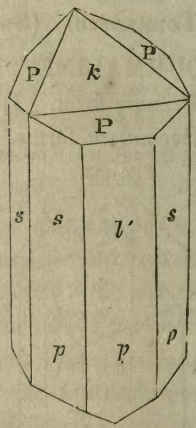
Tourmaline.

Fig. 449.



(Green.)
Paris, (Me.)

Fig. 450.



(Green, red and white.)
Chesterfield, (Mass.)—
Paris, (Me.)

P on *s*	- -	113°	13′	HAUY.
P on *l*	- -	117	9	"
s on *l*	- -	150	00	"
P on *o*	- -	141	40	"
o on *l*	- -	135	44	"
P on *n*	- -	156	43	"
n on *n*	- -	155	9	"
n on *s*	- -	102	26	"
P on *x*	- -	158	25	"
P on *t*	- -	151	5	"
x on *x*	- -	136	50	"
t on *t*	- -	149	26	"
P on *k*	- -	152	51	"

Cleavage, parallel with P and *s* difficult. Fracture imperfectly conchoidal, uneven. Surface, the prisms deep-

ly striated, parallel to the axis; *k* rough, the rest of the faces generally smooth, and of nearly the same physical quality.

Lustre vitreous. Color, brown, green, blue, red, white, frequently black; generally dark colors, rarely bright. Streak white. Transparent . . . almost opake, agreeably to the color. Less transparent if viewed in a direction parallel to the axis than when perpendicular to it, and generally different colors in these directions.

Hardness = 7·0 . . . 7·5. Sp. gr. = 3·076; = 3·021, transparent Rubellite from Paris; = 3·009, of a transparent green variety from Paris; = 3·055 of transparent Indicolite from Paris.

Compound Varieties. Massive: composition seldom granular, of various sizes of individuals; generally columnar, of various sizes of individuals, often very thin, straight and parallel or divergent; sometimes again aggregated into larger granular, or wedge-shaped masses; faces of composition smooth and longitudinally streaked.

1. *Tourmaline* and *Schorl* were formerly distinguished as two particular species, though they differ in no other respects than in color and transparency. Tourmaline included the green, blue, red, brown and white color, (the blue being called *Indicolite* and the red *Rubellite*), while Schorl comprised the black varieties.

2. This species offers a variety of results when heated before the blow-pipe. Some varieties (especially those containing lithia) intumesce and assume a slaggy appearance, but do not melt; others (which contain lime) intumesce still more and melt into a white slag. It assumes by heat, opposite kinds of electricity on the opposite ends of the crystals. The finest, transparent crystals, especially when cut by the lapidary, are constantly electric without artificial heat.

3. *Analysis.*
By GMELIN.

Varieties and localities.			Boracic acid.	Silica.	Alumina.	Protoxide of iron.	Oxide of manganese.	Lime.	Potash.	Soda.	Lithia.	Magnesia.	Loss by heat.
Red Tourmaline.	Rozna.	Sp. gr.=2·960 ... 3·020.	5·74	42·13	36·43	0·00	6·32	1·20	2·41	0·00	2 04	0·00	1·31
Red Tourmaline.	Perme, Siberia.	Sp. gr.=3·059 ... 3·100.	4·18	39·37	44 00	0·00	5 02	0 00	1·29	0·00	2·53	0·00	1·58
Celandine-green.	Brazil.	Sp. gr.=3·079.	4·59	39·16	40·00	5·96	2·14	0·00	0·00	0·00	3·59 with pot.	0·00	1·58
Black.	Devonshire.	Sp. gr.=3·246.	4·11	35·20	35·50	17·86	0·43	0·55	0·00	2·09	0·00	0·70	0·00
Black.	Eibenstock, Saxony.	Sp. gr.=3·123.	1·89	33·05	38·23	23·86	0·00	0·86	0·00	3·17	0·00	0·00	0·45
Green.	Chesterfield, (Mass.)	Sp. gr.=3·102.	3·88	33·80	39·61	7·43	2·88	0·00	0·00	4·95	0·00	0·00	0·78
Black.	Sweden.	Sp. gr.=3·044.	3·83	37·65	33·46	9·38	0·00	0·25	2·53 and soda.	0·00	0·00	10·98	0·03
Black.	Bavaria.	Sp. gr.=3·113.	4·02	35·48	34·75	17·44	1·89	traces.	0 48	1·75	0·00	4·63	0·00
Black.	Greenland.	Sp. gr.=3·062.	3·63	38·79	37·19	5·81	traces.	0·00	0·22	3·13	0·00	5·86	1·86
Brown.	St. Gothard.		4·18	37·81	31·61	7·77	1·11	0·98	1·20 and soda.	0·00	0·00	5·99	0·24

Tourmaline.

4. Tourmaline is frequently met with in rocks, particularly in granite, but without forming a regular ingredient of any, and is found imbedded in them in larger or smaller masses, or crystallized in the drusy cavities, as in the Topaz-rock of Saxony and the granite of Paris, (Me.) The dark brown variety of Monroe, (Conn.) forms with Mica a bed in mica-slate. The cinnamon-red occurs disseminated through dolomite and granular limestone; and the green and red varieties with smoky Quartz form a vein embraced on each side by Albite, traversing granite at Chesterfield, (Mass.) It is also met with in the shape of pebbles, in the stream-works, and in the sand of many rivers.

5. Some of the most remarkable among the foreign localities of Tourmaline are the following; black crystals in Greenland, in the mountains called Hörlberg near Bodenmais in Bavaria, and near Bovey in Devonshire, England; red varieties from Perme in Siberia, Rozena in Moravia; pale green with a tinge of yellow at St. Gothard in dolomite, and green and blue varieties from Brazil and Ceylon, where they are found in the sand of rivers.

The United States is particularly rich in Tourmaline. Paris, (Me.) has thus far yielded the most remarkable crystals for size, color and transparency, and which were found loose in the soil, covering a decomposing ledge of graphic granite. Some of these were upwards of an inch in diameter, transparent, red at one end and green at the other. The granite still continues to afford blue and pink crystals and compound varieties, which are mostly imbedded in Lepidolite; also long slender green crystals and columnar aggregations traversing large individuals of brown Mica. The vein of Tourmalines of Chesterfield, (Mass.) is about one foot in width. The crystals are small, rarely perfect in form, deeply striated, often much curved, and rifted by cross seams into which the Quartz is thrust. The green crystals especially those situated in the smoky Quartz, often contain in their centres prisms of Rubellite, while the single crystals of Tourmaline which have shot into the Albite, are frequently pure red or green. Similar varieties are found at Goshen, where the interior of the crystals is sometimes blue or green, and the exterior a pale rose-color, or some different shade of green or blue. The deep indigo-blue varieties, particularly, abound at Goshen. Monroe, (Conn.) furnishes the most perfect crystals in form, found in the United States. They are of a dark yellowish brown color, and translucent only on their edges. They vary in size from a hazle-nut to two or three inches in length, and one or two in diameter, being universally

perfect at both extremities. A cinnamon-red, and brown variety occurs at Governeur, St. Lawrence co., (N. Y.) in granular limestone with Scapolite, Pyroxene and Apatite, though it is chiefly imbedded by itself in veins of white Quartz. A similar variety is found at Grenville, Lower Canada, Newton, (N. J.) with Corundum, Spinel and Rutile, at Kingsbridge, (N. Y.) and at Carlisle, (Mass.) with Garnet. Black varieties are found at numerous places. The most beautiful have been obtained from Brunswick, (Me.), Monroe and Haddam, (Conn.) and Greenfield, (N. Y.)

6. The red varieties of Tourmaline are highly esteemed in jewellery; when they are transparent and of a fine color, they rank on a level with the oriental ruby. The green and blue varieties are also cut when their color is not too intense.

TREMOLITE. (See *Hornblende.*)

TRICLASITE. (See *Fahlunite.*)

TRIPLITE. Prismatic Parachrose-Baryte.

Massive: cleavage in three directions perpendicular to each other, one of them more distinct. Fracture small conchoidal.

Lustre resinous, inclining to adamantine. Color blackish-brown. Streak yellowish-grey. Translucent on the edges. Opake.

Brittle. Hardness = 5·0 ... 5·5. Sp. gr. = 3·439 ... 3·775.

1. Before the blow-pipe, it melts easily into a black scoria, and is readily dissolved in nitric acid without effervescence.

2. *Analysis.*

By VAUQUELIN.

Oxide of iron	31·00
Oxide of manganese	42·00
Phosphoric acid	27·00

3. It has been found near Limoges in France, in a vein of Quartz in granite, accompanied by Apatite. In the United States, it occurs in considerable quantity at Washington, (Conn.) where it exists as at Limoges

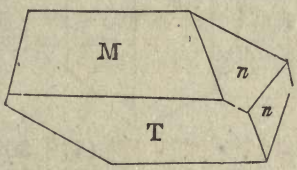
in France, but is associated with pulverulent Diallogite. In small quantity, also, at Sterling, (Mass.) along with Spodumene.

TRONA. Tetarto-prismatic Natron-Salt.

Primary form. Doubly oblique prism. M on T = 103° 15′.

Secondary form.

Fig. 451.



T on *n*	-	-	-	-	103°	15′
n on *n*	-	-	-	-	132	30

Cleavage, perfect parallel to M. Fracture uneven. Surface, M and *n* smooth, T streaked.

Lustre vitreous. Color white, sometimes passing to yellowish-grey. Streak white. Transparent . . . translucent. Rather brittle. Hardness = 2·5 . . . 3·0. Sp. gr. = 2·11. Taste, sharply alcaline.

1. It does net deliquesce in the air.

2. *Analysis.*

Carbonic acid	-	-	-	-	-	-	-	40·24
Soda	-	-	-	-	-	-	-	37·93
Water	-	-	-	-	-	-	-	21·83

3. It is found at Fezzan in Tripoli, where it occurs mingled with the soil and dissolved in water.

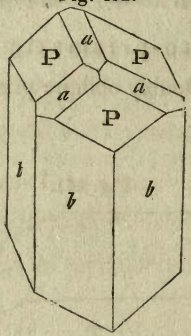
TROOSTITE. Rhombohedral Parachrose-Baryte.

Primary form. Rhomboid. P on P = 115° (c. g.)

Troostite.

Secondary form.

Fig. 452.



P on *a* - - -	147°	30′	c. g.
P on *b* - - -	122	00	"
a on *b* - - -	109	00	"
b on *b* - - -	120	00	"

Irregular forms, grains.

Cleavage parallel with *b* perfect, at right angles to the axis less distinct, with P in traces. Surface, *b* smooth and shining, P and *a* dull. Fracture conchoidal.

Lustre vitreous, inclining to resinous. Color pale asparagus-green, yellow, grey, and reddish-brown; none of them bright. Transparent to translucent.

Brittle. Hardness = 5·5. Sp. gr. = 4·0 . . . 4·1.

Compound Varieties. Massive: composition granular.

1. Heated before the blow-pipe, it becomes transparent and melts on the edges. With borax, it dissolves giving the violet tinge of oxide of manganese. It is dissolved with effervescence in muriatic acid, at the same time giving out chlorine, and leaving a residue of silica.

2. *Analysis.*

By Thomson.

Silica - - - - - -	30·650
Protoxide of manganese - - - - -	46·215
Peroxide of iron - - - - - -	15·450
Loss by heat - - - - - -	7·300

Tungsten.

3. It is found at Sterling, (N. J.) associated with Franklinite. Its crystals are sometimes above an inch in length.

TUNGSTATE OF IRON. (See *Wolfram.*)

TUNGSTATE OF LEAD. (See *Scheeletine.*)

TUNGSTATE OF LIME. (See *Tungsten.*)

TUNGSTEN. Pyramidal Tungstic-Baryte.

Primary form. Octahedron with a square base P on P over the base $=130° 20'$, over the pyramidal edge $=100° 8'$.

Secondary forms.

Fig. 453.

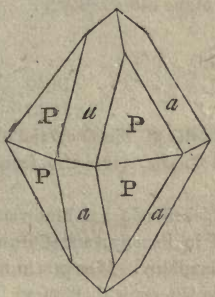
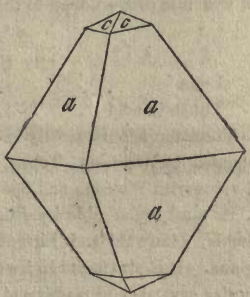


Fig. 454.



Trumbull and Monroe, (Conn.)

Cleavage, parallel with P and *a*; more splendent in the direction of the former, though more interrupted by small conchoidal fracture. Fracture imperfectly conchoidal, uneven. Surface, *a* irregularly streaked, sometimes concave, P and the other faces are generally smooth.

Lustre vitreous, inclining to adamantine. Color generally white, often inclining and passing into yellowish-grey, yellowish and reddish brown, sometimes almost orange-yellow. Streak white. Semi-transparent . . . translucent.

Brittle. Hardness $=4{\cdot}0 \ldots 4{\cdot}5$. Sp. gr. $=6{\cdot}076$, a white cleavable variety from Schlaggenwald.

Compound Varieties. Twin-crystals. Axis of revolution perpendicular, face of composition parallel to faces truncating the base of the octahedron, *a*. The individuals are continued beyond the face of composition. Reniform shapes; surface drusy, composition columnar. Massive: composition granular, faces of composition sometimes irregularly streaked.

1. Heated upon charcoal, it decrepitates at first, and then fuses, but only with great difficulty and on the thinnest edges into a semi-transparent, vitrified mass. It gives a white glass with borax, the transparency of which is proportioned to the quantity of the salt employed.

2. *Analysis.*

By Berzelius.

Lime	19·40
Tungstic acid	80·42

3. Tungsten occurs mostly in the repositories of Tin-Ore, and is accompanied by Wolfram, Topaz, Fluor and Quartz. It is also found in lead veins with Wolfram and Spathic Iron.

4. Its most remarkable localities are Schlackenwald and Zinnwald in Bohemia, Zinnwald and Ehrenfriedersdorf in Saxony, and Cornwall, England. It is also found in Sweden and Dauphiny. It occurs in large irregular crystals and massive at Monroe, in Quartz with Wolfram, Galena, Native Bismuth and Tungstic-ochre; also in the adjoining town of Trumbull in a vein of Topaz, Quartz and Fluor.

TUNGSTIC OCHRE. Tungstic Lusine-Ore.

Massive: composition impalpable; earthy and pulverulent. Fracture earthy.

Color lemmon-yellow.

Soft. Sp. gr. $=6{\cdot}0$.

1. It assumes a greenish hue when strongly heated. It combines with the acids and is soluble in caustic alkalies.

2. It is probably tungstic acid in a state of perfect purity, and therefore consists of Oxygen 13·55. and Tungsten 86·45.

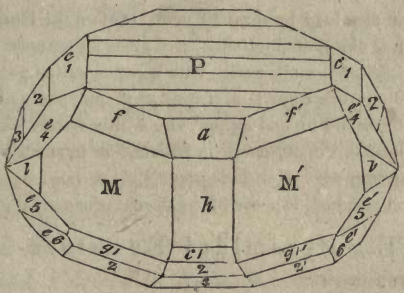
3. It is found associated with Wolfram and Tungsten at Lanes' mine in Monroe, (Conn.) usually in very thin coatings, rarely filling up small cavities.

TURNERITE.

Primary form. Oblique rhombic prism. M on M = 96° 10′. P on M = 99° 40′.

Secondary form.

Fig. 455.



P on *a*	- -	142°	29′	Levy.
P on *f*	- -	133	50	Phillips.
M on *a*	- -	126	10	"
M on *g*1	- -	140	50	Levy.
M on *h*	- -	138	5	"
M on *l*	- -	161	2	"
P on *c*1	- -	155	17	"
P on *c*2	- -	139	25	Phillips.

Cleavage parallel to both diagonals of the primary form, one of them more perfect.

Lustre nearly adamantine. Color several shades of yellow, often inclining to brown. Streak white, sometimes greyish. Transparent . . . translucent.

Scratches Fluor pretty readily, but yields to the knife.

1. According to the blow-pipe experiment of Mr. Children, it consists chiefly of alumina, lime, magnesia, and a little iron with traces of silica.

2. It is found at Mt. Sorel in Dauphiny, attended by Quartz, Feldspar, Albite, Crichtonite and Anatase.

TURQUOISE. Uncleavable Azure-Spar.

Massive: composition impalpable. Fracture conchoidal.

Color blue... green, rather bright. Streak uncolored.

Feebly translucent on the edges... opake.

Hardness = 6·0. Sp. gr. =2·83... 3·00. FISCHER.

1. It is not dissolved by muriatic acid. Before the blow-pipe, it becomes brown in the reducing flame, and gives a green color to it. It is infusible by itself, but melts easily with borax or salt of phosphorus.

2. According to BERZELIUS, it consists of phosphate of alumina and lime, silica, oxide of iron and copper, and a little water.

3. It is found in Persia, either in pebbles, or in small veins, traversing a kind of trap.

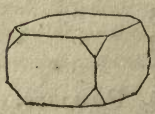
4. Cut and polished, it is used for different ornamental purposes.

URANITE. Pyramidal Euchlore-Mica. MOHS.

Primary form. Right square prism.

Secondary forms.

Fig. 456.

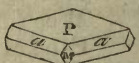


Cornwall.

Fig. 457.

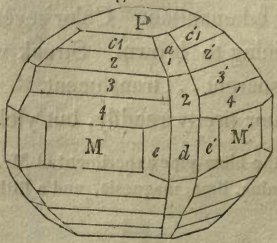
Cornwall.

Fig. 458.



Cornwall.

Fig. 459.



Uranite.

P on *c*1 - -	145°	32′	PHILLIPS.
P on *c*2 - -	140	40	"
P on *c*3 - -	137	10	"
P on *c*4 - -	111	50	"
P on *a*2 - -	134	00	"
*c*4 on *c*4 - -	97	32	"

Cleavage, P highly perfect and easily obtained. Traces of *d*. Fracture not observable. Surface, P smooth, *c* horizontally streaked, M rough.

Lustre pearly upon P, both as faces of crystallization and of cleavage; adamantine upon the other faces. Color emerald-green, and grass-green, less frequently leek-green, apple-green, or siskin-green. Streak corresponding to the color, though paler. Transparent . . . translucent, sometimes only on the edges.

Sectile. Hardness = 2·0 . . . 2·5. Sp. gr. = 3·115.

Compound Varieties. Massive: composition granular, of various sizes, faces of composition rarely observable.

1. Alone before the blow-pipe, it turns yellow and loses its transparency. Upon charcoal, it intumesces a little, and melts into a black globule, with traces of crystallization upon the surface. With borax, it yields a yellowish green bead, and produces a yellow solution in nitric acid.

2. *Analysis.*

	By BERZELIUS. fr. Cornwall.	By BERZELIUS. fr. Autun.	By R. PHILLIPS. fr. Cornwall.
Phosphoric acid	14·62	14 96	16·00
Oxide of uranium	62·52	64·03	60·00
Oxide of copper	8·12	0·00	9 00
Water	14·74	15 04	14·50
Lime	0·00	5·97	0·00
Silica	0·00	0 00	0·50

3. Uranite is found in veins of copper, silver, tin and iron ores, and sometimes also in beds; and is generally accompanied by the other ores of uranium.

4. Beautiful varieties are found in Cornwall. It also occurs at Johanngeorgenstadt, Schneeberg, and Eubenstock; at St. Symphorien near Autun, and at St. Yrieix near Limoges in France.

URANIUM-OCHRE. Uranium Lusine-Ore.

Massive: composition impalpable; earthy and pulverulent.

Color, sulphur-yellow, citron yellow, to brownish or reddish yellow.

1. It affords moisture on being heated in a glass tube. It turns green in the reduction flame of the blow-pipe, without melting.

2. It is believed to be an oxide of uranium, though according to ZIPPE, the variety from Joachimsthal contains carbonic acid.

3. It is found accompanying the Pitchblende in Cornwall and in Bohemia.

URANIUM-ORE. (See *Pitchblende.*)

URANIUM-VITRIOL. (See *Johannite.*)

UWAROWITE.

Crystals small rhombic dodecahedrons.

Lustre vitreous.

Color emerald-green.

Hardness (scale of BREITHAUPT) = 10·0 and above.

1. Locality not mentioned.

VALENCIANITE. (See *Periklin.*)

VANADIATE OF LEAD. (See *Pyromorphite.*)

VARIEGATED COPPER. Octahedral Bronze-Pyrites.

Primary form. Regular octahedron.

Secondary forms.

1. Primary, having its angles truncated.

2. Regular octahedron. Cornwall.

3. Octahedron, with the angles truncated. Cornwall.

Cleavage, traces in the direction of the primary faces. Fracture small conchoidal, uneven. Surface generally

rough, particularly those of the cube, and often curved; much subject to tarnish.

Lustre metallic. Color intermediate between copper-red and pinchbeck-brown. Streak pale greyish-black, a little shining.

Rather sectile. Hardness = 3·0. Sp. gr. = 5·003, from the Bannat.

Compound Varieties. Twin-crystals; axis of revolution perpendicular, face of composition parallel to a face of the octahedron, the individuals being continued beyond the face of composition. Massive; composition granular, strongly connected; fracture conchoidal and uneven.

1. Before the blow-pipe, on charcoal, it melts into a globule, which becomes magnetic, if kept in the blast for some time.

2. *Analysis.*

By PHILLIPS.

Copper	61·07
Sulphur	23·75
Iron	14·00
Silica	0·50

3. It occurs in beds and veins; the crystallized varieties only in veins. It is accompanied chiefly by various other ores of copper.

4. It occurs at Orawitza and other places in the Bannat, associated with Garnet. It is found likewise in beds in the cupriferous shale of the Mansfeld, included in thin layers in the bituminous marl-slate. But it is particularly found in Cornwall, in the vicinity of Redruth. In smaller quantities, it is found in Ireland, Hessia, Silesia, Norway, Sweden, &c.

It has only been met with in a few places in the United States. Thin seams occur in granite, at Chesterfield, (Mass.), and in Pennsylvania, where it occurs under circumstances similar to those mentioned at Mansfield.

VARVICITE.

In radiating and twin-crystals. Cleavage prismatic.

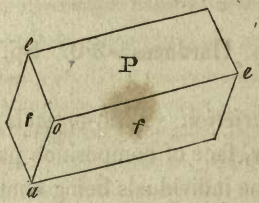
Lustre sub-metallic. Color iron-black to steel-grey. Streak black. Hardness (scale of BREITHAUPT) = 3·0 ... 3·75. Sp. gr. = 4·531, from Warwick; = 4·623, from the Hartz.

VAUQUELINITE. ——— Lead-Baryte.

Primary form. Oblique rhombic prism.

Minute crystals, nearly resembling the annexed figure,

Fig. 460.



if the obtuse edges *o a* be replaced, and the figure be compressed parallel with P, and joined in regular compositions, parallel to a plane, which passes through the crystals in the direction of *e e*, and intersects the acute lateral edges. Inclination of P on P′ from the other individual, nearly 134° 30′; of the edge *o a*, or its replacement on P, about 149°.

Fracture uneven. Surface, P smooth and even, the rest of the faces a little curved.

Lustre adamantine, often faint. Color blackish green, olive-green. Streak siskin-green, often inclining to brown. Faintly translucent, with a fine olive-green tint, opake.

Rather brittle. Hardness =2·5 . . . 3·0. Sp. gr.=5·5 . . . 5·78.

Compound Varieties. Botryoidal, reniform, massive: composition generally impalpable, surface drusy or rough, fracture imperfect and flat conchoidal, lustre faintly resinous.

1. Alone, before the blow-pipe, it intumesces a little, and then froths and melts into a greyish globule, giving at the same time some globules of lead. In the oxidating flame, a small quantity effervesces with, and imparts a green color to, borax and salt of phosphorus, which remains transparent on cooling; but in the reducing flame, the globule turns red and transparent, or red and opake, or finally black, according to the quantity of the mineral employed.

2. *Analysis.*

Oxide of lead	60·87
Oxide of copper	10·80
Chromic acid	28·33

3. It occurs at Beresof in Siberia, along with Red Lead-Ore and Pyromorphite, and is said to be found in Brazil.

Velvet-Blue Copper.

Short capillary crystals, in velvety druses and coatings.

Lustre pearly. Color bright smalt-blue. Translucent.

1. It has been found lining drusy cavities in Limonite, at Moldawa in the Bannat of Temeswar.

Vignite.

Massive: composition granular.

Color dark greenish blue.

Sp. gr. = 3·71. It is magnetic.

2. *Analysis.*

By Karsten.

Oxide of iron	49·14
Protoxide of iron	35·30
Carbonic acid	11 06
Phosphoric acid	4·50

2. It is found in Jura limestone, at Vignes.

3. It appears to belong to the species Magnetic-Iron.

VITREOUS COPPER. Prismatic Copper-Glance. Mohs.

Primary form. Right rhombic prism. M on M = 119° 35′.

Secondary forms.

Fig. 461.

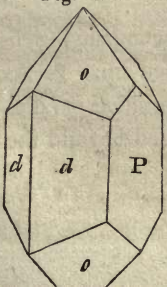
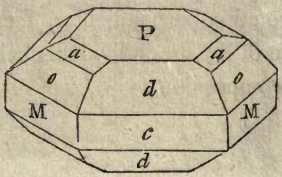


Fig. 462.



Vitreous Copper.

o on *o*	-	-	-	126°	52′
d on *d*	-	-	-	63	00
o on *o* over *d*	-	-	-	80	6

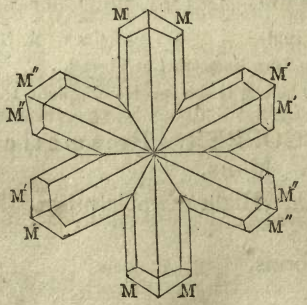
Cleavage, traces of M, very imperfect. Fracture conchoidal. Surface, most of the faces smooth, only the faces at right angles to the axis, and particularly *c*, are streaked horizontally.

Lustre metallic. Color blackish lead grey. Streak unchanged, sometimes shining.

Very sectile. Hardness = 2·5 . . . 3·0. Sp. gr. = 5·695, the compact variety from Bannat.

Compound Varieties. Twin-crystals: 1. Axis of revolution perpendicular to one or both faces of M; face of

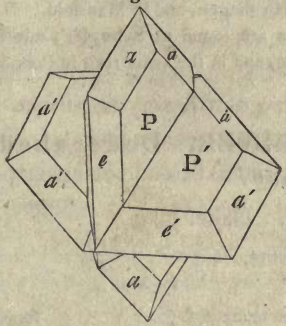
Fig. 463.



composition parallel to it, as in the accompanying figure, only that the re-entering angles are filled up. 2. Axis of revolution perpendicular, face of composition parallel to a face of *a*; the individuals being continued beyond the face of composition.

Vitreous Copper.

Fig. 464.



The inclination of P to P′ is equal to that of the acute terminal edge of *a* on *a′* on one side, and of 91° 51′ on the other; the respective inclinations of *a* on *a′* are =153° 37′, and = 157° 19′. Massive; composition granular, of various sizes of individuals, generally small, and often impalpable; in the last case the fracture becomes uneven, even or flat conchoidal. Plates.

1. In the oxidating flame of the blow-pipe, it melts and emits glowing globules, attended with some noise. In the reducing flame, it becomes covered with a coat, and does not melt. When the sulphur is driven off, a globule of copper remains. If the mineral be treated with nitric acid, the copper is dissolved, forming a green solution; but the sulphur remains undissolved.

2. *Analysis.*

	By Klaproth.	By Ullmann.
Sulphur	18·50	19·00
Copper	78·50	79·50
Iron	2·25	0·75
Silica	0·75	1·00

3. It occurs abundantly in beds and veins, and is accompanied by other ores of copper, by Iron-Pyrites and Quartz.

4. Large and well defined crystals occur in several mines near Redruth in Cornwall. Compound varieties, and rarely distinct crystals, are found in beds in the Bannat of Temeswar, near Catherinenburg in Sibe-

ria, in Mansfield, in Hessia, &c. A foliated variety is found in Cornwall, in the Bannat, in Siegen, and in Mansfeld.

Compact varieties are found at Schuyler's mines, New Jersey, in the old red sandstone, and in the same rock in Connecticut, at Simsbury and Cheshire.

VITREOUS SILVER. Dodecahedral Polypoione-Glance.

Primary form. Cube.

Secondary forms.

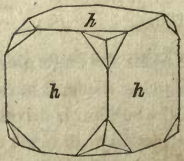
1. Cube, with angles truncated. Freiberg.

2. Regular octahedron. Joachimsthal.

3. Cube, with edges truncated.

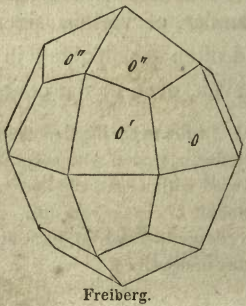
4. Rhombic dodecahedron.

5. Fig. 465.



Freiberg.

6. Fig. 466.



Freiberg.

Cleavage, sometimes traces parallel to the rhombic dodecahedron. Fracture imperfect and small conchoidal, uneven. Surface, nearly of the same description in all the forms, often uneven, and possessing low degrees of lustre. Subject to tarnish.

Lustre metallic. Color blackish lead-grey. Streak shining.

Malleable. Hardness = 2·0 . . . 2·5. Sp. gr. = 7·196 . . . 7·366.

Compound Varieties. Reticulated, arborescent, dentiform, filiform, and capillary shapes: individuals sometimes distinguishable, sometimes impalpable; the dentiform and some other imitative shapes are longitudinally streaked. Massive: composition impalpable; fracture uneven. Plates, and superficial coatings.

1. It is easily fusible before the blow-pipe, attended by intumescence, and it gives a globule of silver by a continuation of the heat. It is soluble in nitric acid.

2. *Analysis.*

	By Klaproth.	By Berzelius.
Silver . . .	85·00	87·05
Sulphur . . .	15·00	12·96

3. It has been found almost exclusively in veins, accompanied by a great variety of species, particularly by ores of silver, lead, and antimony; by Blende, several species of Pyrites, and by Calcareous Spar. Rarely, it is found with Native Gold. The rock adjoining the veins is often impregnated with it, and it is itself covered with Silver-black, which sometimes owes its formation to the decomposition of Vitreous Silver.

4. It occurs at Freiberg, Marienberg, Annaberg, Schneeberg and Johanngeorgenstadt in Saxony; in Bohemia, principally at Joachimsthal; at Schemnitz and Cremnitz in Hungary. Other localities are Siberia, Mexico and Peru.

5. It is a valuable ore for the extraction of silver.

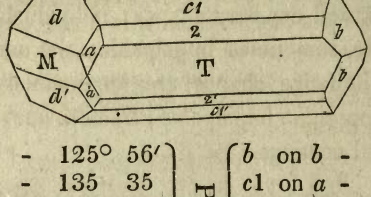
VIVIANITE. Prismatic Iron-Mica.

Primary form. Right oblique-angled prism. M on T = 125° 18′.

Vivianite.

Secondary form.

Fig. 467.



P on c1	125°	56′		b on b	148°	5′
P on d	135	35		c1 on a	140	35
T on c1	143	40	PHILLIPS.	c1 on d	134	5
T on c2	165	25		c1 on b	125	40
T on b	125	25		c on c1	108	30
M on c1	117	40		c1 on c2	157	45
M on d	150	30		d on d	120	45

Cleavage, parallel with P highly perfect; traces in other directions. Fracture, not observable. Surface, P smooth; the rest of the faces streaked parallel to the edges of combination of P.

Lustre pearly, almost metallic on P. The rest of the faces possess vitreous lustre.

Color pale blackish-green ... indigo blue. It is green at right angles to the axis, but of a pure blue color parallel to it. The united effect of both, produces the common dirty indigo-blue color. Streak bluish white, very soon changing to indigo-blue. The powder produced by crushing the mineral in a dry state, is liver-brown. Transparent... translucent; least transparent in the direction of the axis.

Sectile. Thin laminæ are perfectly flexible.

Hardness = 1·5 ... 2·0, the lowest degrees upon P. Sp. gr. = 2·661, crystal from Cornwall.

Compound Varieties. Small reniform and globular shapes, and imbedded nodules; also superficial coatings of

dusty particles. Composition impalpable, earthy or easily reduced to powder.

1. When heated before the blow-pipe, it decrepitates, but if reduced to powder, melts into a dark brown or black scoria, which affects the magnetic needle. It is soluble in dilute sulphuric, and nitric acids. The friable varieties are found white in their original repositories, but like the white powder of the crystals, they soon assume a blue tinge, on being exposed to the air.

2. *Analysis.*

	By Vogel. fr. Bodenmais.	By Thomson. fr. N. Jersey.	By Stromeyer. fr. Cornwall.
Protoxide of iron	41·00	42·65	42·38
Phosphoric acid	26·40	24·00	28 69
Water	31·00	25·00	28·93

3. It is found attending Iron Pyrites in copper and tin veins, in narrow veins traversing greywacke with Native Gold, along with Magnetic Iron, and in trap rocks. The compound friable varieties are imbedded in clay, and in bog-iron ore.

4. It is found with Native Gold at Vöröspatak in Transylvania, at St. Agnes, Cornwall, and in Bodenmais, Bavaria. The earthy variety is found in Carinthia, Stiria, and Thuringia, in the Shetland Islands, and the Isle of Man.

It occurs in considerable abundance at Allentown, Monmouth county, (N. J.) and in its vicinity, imbedded in bog-iron ore, and associated with clays: in the former instance, it is crystallized in nodules, as well as massive; and in the latter, earthy. It is often found in this region filling up Belemnites and Gryphites, in the ferruginous sand formation.

Volkonskoite.

Massive; divisible into laminæ in one direction.

Color grass-green.

1. When thrown into water, it falls to fragments with a hissing noise.

2. It contains about 0·07 oxide of chrome.

3. It is found in the district of Okhousk, Perm in Russia, where it occurs in beds and veins.

Vulpinite. (See *Anhydrite.*)

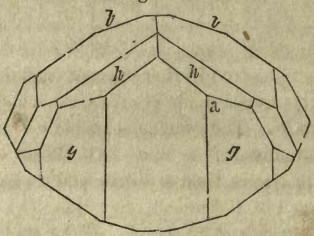
Wad. (See *Pyrolusite.*)

WAGNERITE. Hemi-prismatic Fluor-Haloide. PARTSCH.

Primary form. Oblique rhombic prism. M on M= 95° 25′. P on M=109° 20′.

Secondary form. The primary, having its lateral edges bevelled, the new planes upon the obtuse edges inclining under angles of 117° 32′, those upon the lateral edges under angles of 122° 25′. The bevelling faces on the obtuse edges are likewise truncated. The annexed figure repre-

Fig. 468.



sents the top of the crystal. *a* is not a right angle; *b*, *k*, and *g*, if enlarged, would produce parallel edges of combination.

Lustre vitreous. Color several shades of yellow, sometimes nearly orange-yellow, often inclining to grey. Streak white. Translucent.

Hardness=5·0 . . . 5·5. Sp. gr.=3·01 . . . 3·13.

1. Before the blow-pipe, it melts with difficulty into a dark greenish grey glass. It easily dissolves with borax and salt of phosphorus, into a transparent glass. Treated with warm sulphuric acid, it evolves fluoric acid in the state of powder.

2. *Analysis.*

By FUCHS.

Phosphoric acid	41·73
Magnesia	46·66
Fluoric acid	6·50
Oxide of iron	5·00
Oxide of manganese	0·50

3. It occurs in short and irregular veins of Quartz, in clay-slate, in the valley of Höllgraben, near Werfen in Salzburg.

WATER. Pure Atmospheric-Water. Mohs.

Amorphous. Transparent. Liquid.

Sp. gr. = 1·0. Without odor or taste.

1. It consists of oxygen 88·94, and hydrogen 11·06; but contains various proportions of earthy substances, salts and acids, which considerably affect its taste, odor and specific gravity. If the temperature be below 32°, it assumes the condition of ice, snow or hail, or if sufficiently elevated, it is converted into vapor or steam. The crystals of ice or snow resemble the regular compositions of White Lead-Ore. The grains of hail are compound; those which fall during the changeable season of spring have the form of spheric sections, consisting of thin prisms, radiating from the centre, which prisms are columnar particles of composition, and commonly opake. The hail formed during heavy thunder storms, usually assumes the shape of irregular flattish globules; it is also compound, but often perfectly transparent, and including air bubbles.

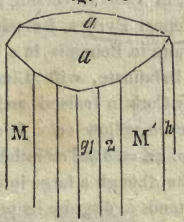
2. Water in its ordinary state, or in the form of dew, mist, rain, snow, hail and ice, is spread over the entire surface of the globe.

WAVELLITE. Prismatic Wavelline-Spar.

Primary form. Right rhombic prism. M on M = 122° 15′.

Secondary form.

Fig. 469.



a on *a*	- -	107°	26′	Phillips.
a on *g*1	- -	122	24	"
*g*1 on *g*2	- -	174	45?	"
*g*1 on *h*	- -	112	30?	"
*g*2 on *h*	- -	112	25	"

Cleavage, parallel with M and the longer diagonal of the base, perfect. Implanted globules; composition columnar. Surface drusy.

Lustre of the faces of cleavage intermediate between pearly and vitreous. Color white, passing into several shades of green, blue, yellow, brown and black. Translucent.

Hardness=3·5...4·0. Sp. gr.=2·337, of the variety from Barnstaple.

1. Before the blowpipe it loses its lustre and transparency, but does not melt. With boracic acid and iron wire, it yields a globule of phosphuret of iron.

2. *Analysis.*

	By Berzelius.	By Fuchs.	By Steinmann. var. Kakoxene.
Alumina	35·35	37·20	10·01
Phosphoric acid	33·40	35·12	17·86
Fluoric acid	2·06	0·00	0·00
Lime	0·50	0·00	0·15
Ox. of iron and mang.	0·00	0·00	Peroxide of iron 36·82
Silica	0·00	0 00	8 90
Water	28·00	28·00	With fluoric acid 25 95

3. It occurs at Barnstaple in Devonshire, in small veins in clay slate; at St. Austle in Cornwall, in veins traversing granite, accompanied by Fluor, Tin-Ore, Yellow Copper Pyrites, &c.; in the Shiant isles in Scotland; at Zbirow near Beraun in Bohemia, in a kind of sandstone or grit; at Amberg in the Upper Palatinate, with Limonite; and in handsome bluish green varieties near Cork in Ireland, and in Brazil. The variety called *Kakoxene*, of an ochre-yellow color from Bohemia, has, according to Breithaupt, a sp. gr. = 3·38, or rather less. It appears, however, to belong to Wavellite, though a large intermixture of decomposed Limonite, or Iron-Ochre, tends to disguise its properties.

WEBSTERITE.

Reniform, massive: composition impalpable. Surface dull. Fracture fine grained and earthy. Friable.

Color white. Streak white, a little glimmering. It soils. Opake.

Sp. gr.=1·669.

1. It is fusible with difficulty. It is readily soluble in the acids. It imbibes water, but does not in consequence, fall to pieces.

2. *Analysis.*

	By Stromeyer.		By Dumas.
	fr. Halle.	fr. Newhaven.	fr. Auteuil.
Alumina	30·262	29·868	30·0
Sulphuric acid	23·365	23·270	23·0
Water	46·327	46·762	47·0

3. It is found at Halle in Prussia, in beds of plastic clay, and also filling up fissures in chalk, and in small globular masses, at Newhaven in Sussex, and at Auteuil near Paris.

Weissite.

Primary form. Oblique rhombic prism.

Lustre pearly. Color ash-grey. Translucent.

Hardness, scratches glass.

1. *Analysis.*

By Wachmeister.

Silica	53·69
Alumina	21·70
Magnesia	8·99
Protoxide of iron	1·43
Protoxide of manganese	0·63
Potash	4·10
Soda	0·68
Oxide of zinc	0·30
Water	3·20

2. It is found with a chloritic Talc in Erik-Matts, at Fahlun in Sweden.

Wernerite. (See *Scapolite.*)

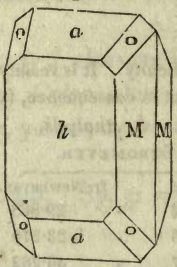
WHITE ANTIMONY. Prismatic Antimony-Baryte. Mohs.

Primary form. Right rhombic prism. M on M = 136° 58′.

White Antimony.

Secondary form.

Fig. 470.



h on *a* - - - - 144° 44′

Cleavage, parallel to M highly perfect, and easily obtained. Fracture not observable. Surface, M very even, though sometimes a little rough; *h* smooth and even; *a* and *o* curved.

Lustre adamantine, particularly upon the curved faces; upon *h*, often pearly lustre. Color white, prevalent; passing into peach-blossom-red and ash-grey. Streak white. Semi-transparent... translucent.

Sectile. Hardness=2·5...3·0. Sp. gr.=5·566, the simple crystals from Braunsdorf.

Compound Varieties. Crystals, compressed between *h* and *h*, are joined parallel to this face. If the individuals be very thin, the common varieties of this species are formed, which were formerly considered as simple forms, and the faces of composition as faces of cleavage. Massive: composition granular, lamellar, columnar; faces of composition of the granular individuals, in general, irregularly streaked.

1. It melts in the flame of the candle. Before the blow-pipe upon charcoal, it is entirely volatilized, and produces a white coating upon the

support. It is soluble in nitro-muriatic acid. It is frequently produced during chemical operations, and crystallized from sublimation.

2. It consists of

Antimony	84·32
Oxygen	15·68

3. It occurs in small quantities in veins, traversing primitive or grey-wacke rocks, associated with ores of lead and antimony, with Blende, Calcareous Spar and Quartz.

4. Beautiful varieties of aggregated tabular crystals are found at Przibram in Bohemia, and prisms of considerable thickness at Braünsdorf in Saxony. Other localitities are Malaczka in Hungary, Baden in Nassau, and Allemont in Dauphiny.

WHITE ARSENIC. Octahedral Arsenic-Acid. Mohs.

Primary form. Regular octahedron.

Reniform, botryoidal, stalactitic, thin crusts. Massive: pulverulent.

Color white, often inclining to yellow. Streak white. Lustre vitreous, inclining to adamantine. Translucent... opake.

Sp. gr.=3·698. Taste sweetish astringent.

1. If exposed to a high degree of temperature, it is entirely volatilized; upon ignited charcoal, it emits a strong garlick smell. Its white smoke condenses itself again upon cold bodies. It is soluble in water.

2. *Analysis.*

By Berzelius.

Arsenic	75·82
Oxygen	24·18

3. It is found in metalliferous veins, where it probably owes its existence to the decomposition of other minerals. It has been found at Andreasberg in the Hartz, at Joachimsthal in Bohemia, and at Bieber in the principality of Hanau, &c.

WHITE COPPERAS.

Crystals, having six lateral faces terminated by pyramids, with six truncated faces; the angle which two faces of the pyramid, form = 128° 8′, their inclination to the lateral faces =119°, and their angles with the truncature =151°.

Color white, with a pale tinge of violet.

Compound Varieties. Massive: granular.

1. It is wholly dissolved in cold water; but in hot, it deposits oxide of iron and silica.

2. *Analysis.*

	By Rose.	
Silica	0·31	0·37
Sulphuric acid	43·55	43·55
Oxide of iron	24·11	25·21
Alumina	0·92	0·78
Lime	0·73	0·14
Magnesia	0·32	0·21
Water	30·10	29·98

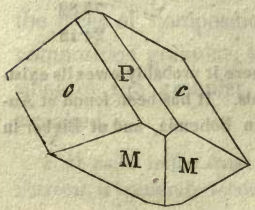
3. It is found in abundance in the province of Copiapo, a province in the north of Chili, near Bolivia; and is apparently derived from the decomposition of a bed of Iron and Copper Pyrites, mingled with Feldspar.

WHITE IRON-PYRITES. Prismatic Chlorone-Pyrites.

Primary form. Right rhombic prism. M on M = 106° 2′.

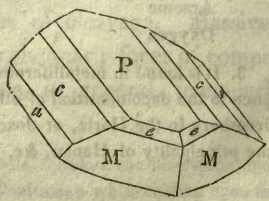
Secondary forms.

Fig. 471.



Warwick, (N. Y.)

Fig. 472.



Cornwall.

White Iron-Pyrites.

P on *c*	-	-	-	-	160° 48′
P on *a*	-	-	-	-	130 00
a on *c*	-	-	-	-	141 30

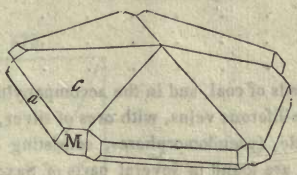
Cleavage, parallel with M rather perfect. Fracture uneven. Surface, *c* and *a* deeply streaked parallel to their edges of combination with P.

Lustre metallic. Color pale bronze-yellow, sometimes inclining to green or grey. Streak greyish-black, or brownish black.

Brittle. Hardness = 6·0 ... 6·5. Sp. gr. = 4·678, crystals from Schemnitz; 4·847, crystals from Littmitz.

Compound Varieties. Twin-crystals: 1. Face of composition parallel, axis of revolution perpendicular to a face of M. This composition is generally repeated, as in the annexed figure, where a group of five individuals is formed,

Fig. 473.



having much the appearance of a five-sided pyramid with truncated apices, each of the five solid angles at the base presenting a re-entering angle. 2. Face of composition parallel, axis of revolution perpendicular to *a* and *c*. This composition takes place in varieties already compounded by the first law. They assume a grooved appearance. The re-entering angle formed by the faces P = 114° 19′. Globular, reniform, stalactitic and other imitative shapes: surface drusy; composition columnar, individuals straight,

and generally small, or even impalpable. There is sometimes a second curved lamellar or granular composition, the faces of composition being uneven or rough. Massive: composition as in the imitative shapes; fracture even, flat conchoidal, uneven. Pseudomorphoses in low, nearly regular, six-sided prisms. Cellular.

1. The present species has been subdivided into varieties depending upon the shape and composition of the crystals, and several accidental circumstances. The crystals of *Radiated Pyrites* are generally simple. *Spear Pyrites* is found only in compound crystals, consisting of two, three, or a greater number of individuals regularly grouped. *Cockscomb Pyrites* occurs both in simple and in compound crystals of a particular form, with indentations along their edges, and a color much inclining to green or grey.

2. Before the blow-pipe, it becomes red upon charcoal, the sulphur is driven off, and oxide of iron remains. Some of the varieties are particularly liable to decomposition.

3. *Analysis.*

By BERZELIUS.

Sulphur	53·35
Iron	45·07
Manganese	0·70

4. It abounds in beds of coal, and in the accompanying strata of clay. It also occurs in metalliferous veins, with ores of silver, lead and copper.

5. Radiated, hepatic, (pseudomorphoses, consisting of Iron Pyrites,) and cellular Pyrites, are found in several parts of Saxony; hepatic pyrites at Johanngeorgenstadt, radiated and spear Pyrites at Joachimsthal, Littmitz and Altsattel in Bohemia; the former also at Schemnitz in Hungary, and Almerode in Hessia; Cockscomb Pyrites in Derbyshire. Spear Pyrites and Radiated Pyrites, in beautiful stalactitic groups, abound in Cornwall.

Crystallized varieties of this species are only known from Warwick, (N.Y.) in the United States, where they occur in single crystals, imbedded, with Zircon, in granite. Massive, fibrous varieties, abound throughout the mica-slate formation of New England, in particular with Cummingtonite and Garnet, in Cummington, (Mass.) It is found at Lane's mine in Monroe, and in the Topaz and Fluor vein at Trumbull, (Conn.); in gneiss at East Haddam, and in numerous other places.

White Lead-Ore.

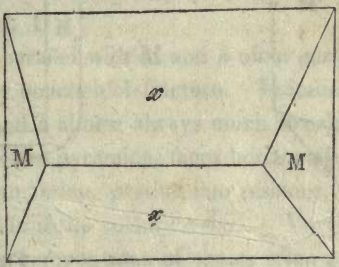
5. It is employed, like the Iron Pyrites, in the manufacture of sulphur, copperas and sulphuric acid.

WHITE LEAD-ORE. Di-prismatic Lead-Baryte. Mohs.

Primary form. Right rhombic prism. M on M=117°.

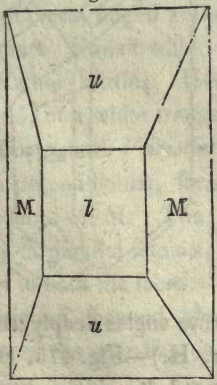
Secondary forms.

Fig. 474.



Nertschinsk, Siberia.

Fig. 475.



Johanngeorgenstadt.

Fig. 476.

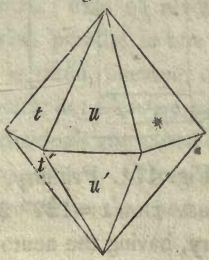


Fig. 477.

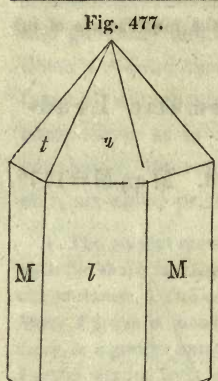


Fig. 478.

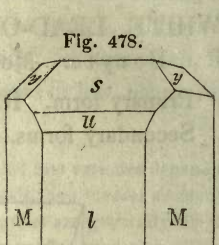


Fig. 480.

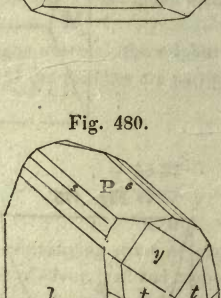


Fig. 479.

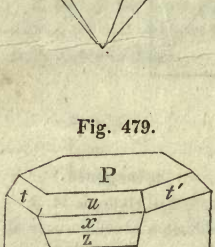


Fig. 474. Primary, having the acute angles deeply truncated. x on $x = 127° 20'$. (*octaèdre*. H.)—Fig. 475. Primary, having the acute angles replaced by single planes, and the acute lateral edges truncated. l on $u = 144° 44'$,

(H.) M on $l=121° 28'$. (H.) (*quadrihexagonal.* H.)—Fig. 476. The same, with the addition of the replacement of the obtuse angles by two planes. t on $t'=107° 6'$. (*dodécaèdre.* H.)—Fig. 477. A combination of fig. 475 and fig. 476. M on $t = 143° 33'$. (H.) (*trihexaèdre.* H.)—Fig. 478. l on $s=109° 29'$. (H.) (*sexduodécimal.* H.)—Fig. 479. P on $t=126° 27'$. (H.) P on $u=125° 16'$. (H.) P on $x=116° 20'$. (H.) P on $z=109° 29'$. (H.) (*octovigésimal.* H.)

Cleavage, parallel with M and h often perfect, generally interrupted by conchoidal fracture. Fracture conchoidal. Surface, M and h almost always much streaked vertically, and several of the pyramidal faces horizontally.

Lustre adamantine, passing into resinous. The former is often metallic if the colors be dark. Very thin crystals, and columnar compositions of them, often possess pearly lustre. Color white, prevalent, passing into yellowish grey, ash-grey, and smoke-grey, or even into greyish black. Sometimes, tinged green or blue by several of the salts of copper. Streak white. Transparent . . . translucent.

Rather brittle. Hardness = 3·0 . . . 3·5. Sp. gr. = 6·465, of a white translucent variety.

Compound Varieties. Twin-crystals; axis of revolution perpendicular, face of composition parallal to one of the faces of M. The composition is often repeated, not only in parallel laminæ, as in Arragonite, but likewise parallel to both the faces of M. The individuals are generally continued beyond the face of composition. Thus are formed the star-like crystals represented in the annexed

White Lead-Ore.

Fig. 481.

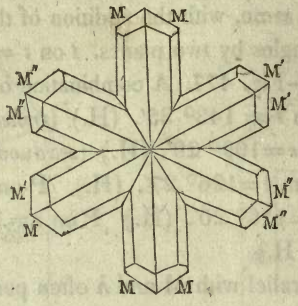


figure. Massive: compostion often granular, or even impalpable, and strongly connected, more rarely columnar. Faces of composition rough, or longitudinally or irregularly streaked.

1. Before the blow-pipe, it decrepitates, and changes its color into yellow and red; if properly managed, it yields a globule of metallic lead. Reduced to powder, and thrown upon ignited charcoal, it emits a phosphorescent light. It dissolves with effervescence in dilute nitric acid.

2. *Analysis.*

By KLAPROTH.

Oxide of lead	82·00
Carbonic acid	16·00
Water	2·00

3. It occurs in veins and beds in various classes of rocks, accompanied chiefly by Galena and other salts of lead.

4. Fine crystallized varieties occur in the various mining districts of Saxony, Hartz, Bohemia, Carinthia and France. Splendid crystals are brought from the Daurian mountains in Siberia, on the frontiers of China. Very beautiful varieties are found at Wanlockhead and the Lead Hills in Scotland, in the mines of Cumberland and of Cornwall.

Very distinct and beautiful crystals were formerly obtained at the Perkiomen Lead mine near Philadelphia. It also exists in Missouri, at Valle's Diggings, Jefferson co.; and in small quantity at the Southampton lead mine, (Mass.)

WHITE VITRIOL. Prismatic Vitriol-Salt. Mohs.

In efflorescences and crusts. It crystallizes in right rhombic prisms. M on M = 90° 42′.

Lustre vitreous. Color white. Translucent.

Brittle. Hardness = 2·0 ... 2·5. Sp. gr. = 2·036. Taste astringent, nauseous and metallic.

1. It is very easily soluble in water; before the blow-pipe it froths, and covers the charcoal with a white coating.

2. *Analysis.*

By Klaproth.

Oxide of zinc	27·5
Oxide of manganese	0·5
Sulphuric acid	20·0
Water	50·0

3. It arises from the decomposition of Blende, and is found in small quantity in the Rammelsberg near Goslar in the Hartz, at Schemnitz in Hungary, at Fahlun in Sweden, at Holywell in Flintshire.

WILLEMITE. Axotomous Zinc-Baryte.

Primary form. Rhomboid. P on P about, = 133°.

Secondary form. Six-sided prism terminated by the faces of the primary rhomboid.

Cleavage, indistinct, perpendicular to the axis of the rhomboid, or parallel with the base of the six-sided prism.

Lustre resinous. Color white, yellowish or red. Translucent or opake.

Hardness = 5·0 ... 5·5. Sp. gr. = 4·0 ... 4·1.

Compound Varieties. Reniform. Massive, impalpable. Color reddish brown.

1. It consists of a silicate of zinc with a very little oxide of iron.
2. It occurs with Calamine upon the Old mountain in Limburg.

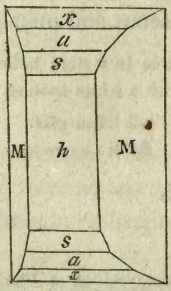
Withamite. (See *Epidote.*)

WITHERITE. Di-prismatic Hal-Baryte. Mohs.

Primary form. Right rhombic prism. M on M=118° 30′.

Secondary form.

Fig. 482.



Anglesack.

M on M′	-	-	61° 30′	Phillips.
h on *s*	-	-	145 30	"
h on *a*	-	-	126 16	"
h on *x*	-	-	110 30	"

Cleavage, parallel with M and *h* imperfect. Fracture uneven. Surface, M horizontally streaked.

Lustre vitreous, inclining to resinous. The latter more distinct in the fracture. Color white, generally yellowish, approaching to orange-yellow; sometimes passing into various shades of grey. Streak white. Semi-transparent... translucent.

Brittle. Hardness = 3·0...3·5. Sp. gr. = 4·301, a white semi-transparent cleavable variety.

Compound Varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel to a face of M. The individuals continued beyond the face of com-

position. The composition repeated, so as to give rise to a six-sided prism, as in Arragonite. Globular, tuberose, reniform, botryoidal shapes: surface rough, uneven, and drusy; composition granular, often strongly coherent. Massive: composition either granular, or columnar; more frequently the latter.

1. Before the blow-pipe, it decrepitates slightly, and melts easily into a transparent bead, which loses its transparency on cooling. It is soluble with effervescence in dilute nitric acid.

2. *Analysis.*

By Bucholz.

Baryta	79·66
Carbonic acid	20·00
Water	0·33

3. It occurs in veins traversing limestone which rests upon red sandstone; it is also found in lead-veins traversing greywacke, and in irregular beds along with Ankerite in clay-slate.

4. It exists abundantly in the counties of Durham, Westmoreland, Lancaster, and Salop, (England) in veins; also near Neuberg in Stiria in irregular beds. It has been mentioned from Hungary, Salzburg, Siberia, Sicily, and other places.

5. It is a violent poison.

Wœrthite. (See *Kyanite.*)

Wolchouskoit.

Massive: composition impalpable. Fracture conchoidal. Color bluish green. Streak similar to color. Opake, adheres slightly to the tongue.

1. It consists of silica, alumina, oxide of chrome and water.
2. It is found in Siberia.

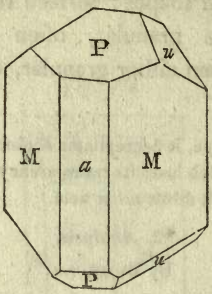
WOLFRAM. Prismatic Baryte-Ore.

Primary form. Oblique rhombic prism. M on M = 98° 12′.

Wolfram.

Secondary form.

Fig. 483.



Zinnwald.

P on *a* - - -	116° 34′
u on *u* over P - - -	98 12

Cleavage, parallel with *a* perfect. Fracture uneven. Surface, M and *a* streaked vertically. P sometimes curved.

Lustre metallic adamantine, or imperfectly metallic. Color dark greyish or brownish black. Streak dark reddish-brown. Opake.

Not very brittle. Hardness = 5·0 . . . 5·5. Sp. gr. = 7·155.

Compound Varieties. Twin-crystals: 1. Face of composition parallel, axis of revolution perpendicular to *a*. 2. Face of composition parallel, axis of revolution perpendicular to a face of *u*. There is often a curious composition in the exterior of crystals parallel to all their faces. Massive: composition irregularly lamellar, easily separated, faces of composition irregularly streaked; also columnar, the individuals being generally of a considerable size, straight

and divergent, and often rather strongly coherent. Pseudomorphoses in the shape of Tungsten.

1. When heated before the blow-pipe, it decrepitates, but may be melted in a sufficiently elevated temperature into a globule, having its surface covered with crystals possessing a metallic lustre. It dissolves readily in borax.

2. *Analysis.*

By Berzelius.

Tungstic acid	78·77
Protoxide of manganese	6·22
Protoxide of iron	18 32
Silica	1·25

3. It is frequently met with attending Tin-ore, in veins and beds. It also accompanies Galena in veins, traversing greywacke, and is found in beds and veins of Quartz, with Galena, Native Bismuth, Blende, &c.

4. It abounds in nearly all the tin-mines of Europe, and occurs in several places at Cornwall. It exists in greywacke in the principality of Anhalt; in the island of Rona one of the Hebrides, in graphic granite, and in Siberia with Beryl.

It is found in cleavable masses, columnar and nearly impalpable, and in large pseudomorphous crystals, at Lane's mine in Monroe, (Conn.) where it is associated with Tungsten, Tungstic-Ochre, Blende, Galena, Iron Pyrites, Native Bismuth, &c.; also in Trumbull, (Conn.) in the Topaz vein, but in smaller quantity.

Wollastonite. (See *Tabular-Spar.*)

Wolnin. (See *Heavy-Spar.*)

Wood-Copper. (See *Olivenite.*)

Wood-Opal. (See *Opal.*)

Wood Tin. (See *Tin-Ore.*)

Xanthite. (See *Idocrase.*)

XENOTIME. Prismatoidal Tungstic-Baryte.

Pimary form. Octahedron with a square base.

Xenotime.

Secondary form. The primary having the edges of the base deeply truncated.

Lustre resinous. Color yellowish brown.

Hardness = 4·5 . . . 5·5? Sp. gr. = 4·557.

1. Alone before the blow-pipe, it is infusible; but with soda, it affords a brisk effervescence and an infusible scoria.

2. *Analysis.*

By Berzelius.

Phosphoric acid with a little fluoric acid . .	33·49
Yttria	62.58
Sub-phosphate of iron	3·93

3. It has been found in small, imperfect crystals, near Lindenaes in Norway, in granite with Orthite.

Xylokryptite.

In delicate crystals.

Lustre vitreous. Color yellow.

1. It occurs in Lignite. Locality not mentioned.

Yellow Copperas.

In irregular six-sided tables, and in grains. Lustre pearly. Color yellow. Transparent.

1. *Analysis.*

By Rose.

Sulphuric acid	39·60
Oxide of iron	26·11
Alumina	1·95
Magnesia	2·64
Silica	1·37
Water	29·67

2. It is found investing white Copperas in the district of Copiapo, a province of Coquimbo.

Appendix to White Copperas.

i. *Fibrous Yellow Copperas.*

In fibrous concretions.

Lustre silky. Color yellowish green.

2. *Analysis.*
By Rose.

Sulphuric acid	31·73
Oxide of iron	28·11
Lime	0·91
Magnesia	0·59
Water	36·56
Silica	1·43

2. It is found with the above.

YELLOW COPPER PYRITES. Pyramidal Chlorone-Pyrites.

Primary form. Octahedron with a square base. P on P″ = 102° 55′.

Secondary forms.

Fig. 484.

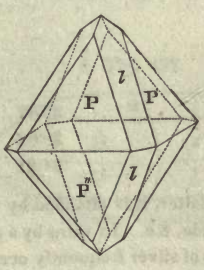
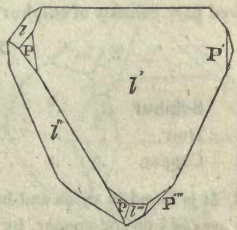


Fig. 485.



P on l	-	-	141° 15′	Phillips.
l on l	-	-	110 00	"
l' on l'''	-	-	71 10	"
P on P″	-	-	125 30	"

Fracture conchoidal, more or less perfect. Surface, P streaked, parallel with the base; the alternating faces enlarged, faces of l are irregularly streaked. The remaining faces are almost all smooth, and often possess a high lustre.

Lustre metallic. Color brass-yellow. Streak greenish-black, a little shining.

Rather sectile. Hardness = 3·5 . . . 4·0. Sp. gr. = 4·169.

Compound Varieties. Twin-crystals: face of composition perpendicular to a face of P, similar to the common hemitrope in the regular octahedron. Globular, reniform, botryoidal, stalactitic, and other imitative shapes: surface generally rough, sometimes also smooth, composition impalpable, fracture flat conchoidal. Massive: composition granular, of various sizes of individuals, often impalpable, and strongly coherent, fracture uneven or flat conchoidal.

1. Upon charcoal, it becomes black before the blow-pipe, and red on cooling. It melts into a globule, which becomes magnetic if kept in the blast for some time. With borax, it yields a globule of copper. It is partly soluble in dilute nitric acid; the solution is green, and the undissolved part consists of sulphur.

2. *Analysis.*

By Rose.

Sulphur	35·37
Iron	29·82
Copper	34·81

3. It is found in veins and beds. In the latter, it is attended by various ores of iron and copper, by Galena, Blende, &c. In veins by a great variety of species among which several ores of silver frequently occur.

4. It occurs in numerous countries; but the finest crystals come from Freiberg and Cornwall. It occurs in the United States at several places; at the Southampton (Mass.) lead-mine with Galena and Blende, at Franconia, (N. H.) in gneiss, at Strafford and Schrewsbury, (Vt.) with Magnetic Iron Pyrites, &c.

5. It is a very valuable ore for the production of copper.

YELLOW LEAD-ORE. Pyramidal Lead-Baryte. Mohs.

Primary form. Octahedron with a square base. P on P″ = 130° 11′.

Yellow Lead-Ore.

Secondary forms.

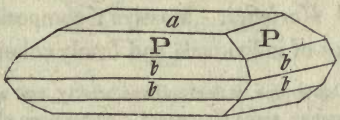
1. Primary with the summits truncated.

2. The same, with the edges of the base truncated.

3. The same as 1. with the angles of the base truncated.

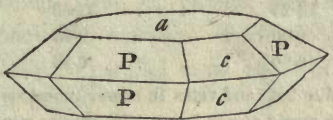
4. Right square prism.

5. Fig. 486.



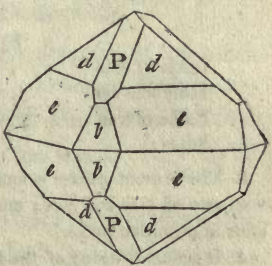
Annaberg, Austria.

6. Fig. 487.



Bleiberg, Carinthia.

7. Fig. 488.



Bleiberg, Carinthia.

1. (*basé.* H.)—2. (*sexoctonal.* H.)—3. (*epointé.* H.)—4. (*bisunitaire.* H.)—5. *b* on *b* = 99° 40′.—6. *c* on *c* = 128° 9′.—7. *d* on *d* = 118° 26′, *e* on *e* = 106° 44′.

Cleavage parallel to *b* very smooth, but often interrupted by conchoidal fracture: parallel to P and *a* less distinct, and not observable in every individual. Fracture conchoidal, generally imperfect. Surface *a* and particularly *b*, smooth; *a* sometimes striated parallel to the edges of

combination with *b*. *c* commonly, P often, and *e* always, rough.

Lustre resinous. Color generally wax-yellow; passing into siskin-green and olive-green, also into orange-yellow, yellowish-grey and greyish white. Streak white. Semi-transparent, translucent on the edges.

Brittle. Hardness = 3·0. Sp. gr. = 6·760, orange yellow, crystals from Annaberg in Austria.

Compound Varieties. Massive: composition granular, of various sizes of individuals and firmly coherent.

1. Before the blow-pipe, it decrepitates briskly, and assumes a darker color, which however, again disappears. Alone upon charcoal, it melts and is absorbed by it leaving behind some reduced globules of metallic lead. It is with difficulty soluble in acids.

2. *Analysis.*

	By Klaproth.	By Hatchett.
Oxide of lead	64·42	58·40
Molybdic acid	34·25	38·00
Oxide of iron	0·00	2·08
Silica	0·00	0·28

3. The present species is found in beds and veins in newer limestone, with ores of lead and zinc; more rarely also in veins with similar minerals in primitive rocks.

4. It occurs in many of the lead mines of Carinthia, as at Deutsch-Bleiberg and Windisch-Bleiberg, Windisch Kappel, &c. also at Annaberg in Austria. It is likewise found in limestone at Annaberg; and in the copper mines of Rezbanya in Upper Hungary. Other localities are Zimapan, Mexico and Moldawa, Bannat; at the latter place it is found in crystals of a hyacinth-red color. In the United States it occurs at the Perkiomen lead-mines, near Philadelphia, and in the lead-mine of Southampton, (Mass.); but at both of these places in limited quantities.

Yellow Tellurium. (See *Mullerite*.)

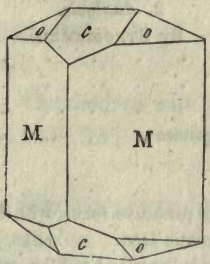
YENITE. Di-prismatic Iron-Ore. Mohs.

Primary form. Right rhombic prism. M on M = 112° 37′.

Yenite.

Secondary form.

1. Fig. 489.



Elba.

o on *o*	-	-	-	-	139°	37′
o on *o* over M	-	-	-		77	16

2. The same with edges bevelled, together with planes between the bevelling planes and the summits.

Cleavage, parallel with the longer diagonal of the prism distinct; less so, parallel with M. Fracture imperfectly conchoidal, uneven. Surface, lateral planes streaked vertically, *o* parallel to its edges of combination between M and *a*.

Lustre imperfectly metallic. Color intermediate between iron-black and dark greyish black, passing into greenish black. Streak black, sometimes inclining to green or brown. Opake.

Brittle. Hardness = 5·5 ... 6·0. Sp. gr. = 3·994, a crystalline variety from Elba.

Compound Varieties. Massive: composition columnar, thin and straight, sometimes granular, the individuals being scarcely distinguishable.

1. After having been exposed to heat, it acts on the magnetic needle. Before the blow-pipe, it melts easily and without effervescence

into an opake glass, which is likewise magnetic. Glass of borax is colored by it, yellowish green. It is soluble in muriatic acid.

2. *Analysis.*

By STROMEYER.

Silica	29·278
Protoxide of iron	52·542
Lime	13·777
Protoxide of manganese	1·587
Alumina	0·614
Water	1·268

3. It is found in beds in primitive rocks, with Pyroxene, Hornblende, Garnet, Quartz and Magnetic Iron.

4. Its principal locality is the island of Elba, where it is found in crystals of considerable size. Other places where it is found, are Kapferberg in Silesia, Norway, and Siberia. But a single locality is known in the United States, which is at Cumberland, (R. I.) where it exists in long slender crystals traversing Quartz in seams and associated with Magnetic Iron and Hornblende.

YTTRO-CERITE. Prismatic Fluor-Haloide.

Primary form. Oblique rhombic prism?

Massive: composition granular. Cleavage parallel with the sides of an oblique rhombic prism, whose lateral planes incline under angles of about 108° 30′. Fracture uneven. Lustre vitreous to pearly.

Color vitriol-blue, inclining to grey and white; sometimes white on the surface. Opake.

Hardness = 4·5. Sp. gr. = 3·447.

1. Before the blow-pipe, it loses its color and becomes white before it glows, but is infusible by itself. With sulphate of lime, it melts into a globule, which becomes white on cooling.

2. *Analysis.*

By BERZELIUS.

Lime	47·63
Fluoric acid	25·05
Yttria	9·11
Oxide of cerium	18.22

3. It occurs at Finbo and Broddbo, near Fahlun in Sweden with Albite and Beryl, and is imbedded in Quartz.

YTTRO-TANTALITE. Monotomous Eruthrone-Ore.

Primary form. Octahedron with a square base? P on P over the base $=129° 32'$.

In grains.

Cleavage in one direction pretty distinct. Fracture conchoidal, uneven, granular.

Lustre, iron-black, brownish black, yellowish brown. Streak grey, or greyish white. Translucent to opake.

Brittle. Hardness, scratches glass. Sp. gr. $=5{\cdot}39 \ldots 5{\cdot}88$.

1. It is infusible before the blow-pipe. In a powerful heat it assumes a yellowish or white color. It fuses with borax into a glass colored by iron. It is not attacked by acids.

2. *Analysis.*

By Berzelius.

	black variey.	yellow variety.	brown variety.
Columbic acid	57·00	60·124	51·815
Yttria	20·25	29·780	38·515
Lime	6·25	0·500	3·260
Oxide of iron	3·50	1·155	0·555
Oxide of uranium	0·50	6·622	1·111
Tungstic acid	8·25	1·024 with tin	2·592

3. It occurs at Ytterby, and near Fahlun in Sweden.

Zeagonite. (See *Gismondin.*)

Zeolite. (See *Mesotype.*)

ZINKENITE. Peritomous Antimony-Glance. Partsch.

Primary form. Right rhombic prism. M on M $=120°$ 39′.

In twin-crystals, and massive. The twin-crystals are six-sided prisms surmounted by six-sided pyramids whose faces correspond to the edges of the prism. The faces of the pyramid incline to one another under angles of 165° 30′, and to the lateral faces under 103°. The composition takes place like that of Witherite. Surface, the prismatic faces striated lengthwise.

Cleavage not observable. Fracture uneven. Lustre metallic. Color steel-grey.

Hardness=3·5. Sp. gr.=5·30 . . . 5·35.

1. Heated before the blow-pipe on charcoal, it decrepitates and melts very easily into small metallic globules, which are volatilized; during which, the charcoal is covered with a yellowish white crust.

2. *Analysis.*

By Rose.

Sulphur	21·68		22·58
Antimony	43·45		44·39
Lead	34.87		31·84
Copper	0.00		0·42

3. It is found at Wolfsberg in the Hartz, where it occurs imbedded in Quartz.

ZIRCON. Pyramidal Zircon. Mohs.

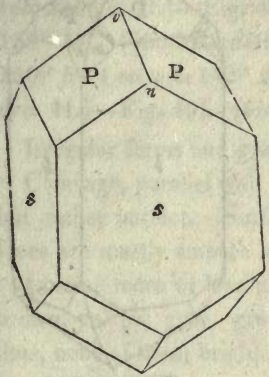
Primary form. Octahedron with a square base. P on P over the base =84° 20′, over a pyramidal edge =123° 19′.

REESE LIBRARY OF THE UNIVERSITY OF CALIFORNIA

Zircon.

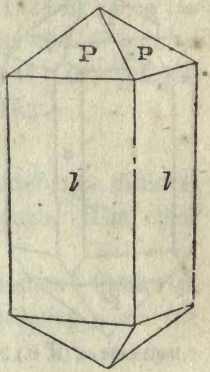
Secondary forms.

Fig. 490.



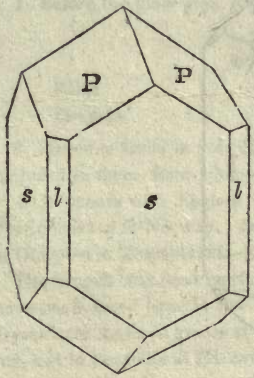
Haddam, (Conn.)

Fig. 491.



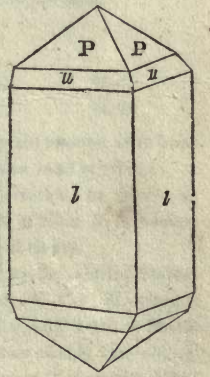
Buncombe co. (N. C.)

Fig. 492.



Warwick, (N. Y.)

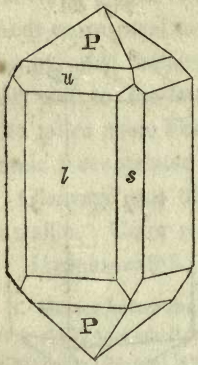
Fig. 493.



Edenville, (N. Y.)

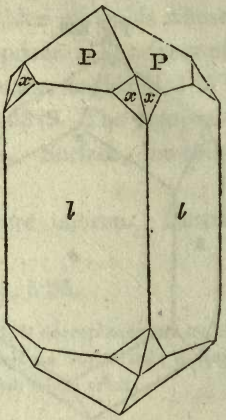
Zircon.

Fig. 494.



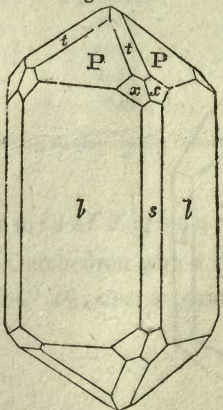
Buncombe co. (N. C.)

Fig. 495.



Middlebury, (Vt.)

Fig. 496.



Middlebury, (Vt.)—
Munroe, (N. Y.)

Fig. 490. The primary, having the angles of the base truncated. P on $s = 117° 48'$. (*dodécaèdre*. H.)—Fig. 491. The primary having the edges of the base truncated.

Zircon.

P on $l = 131° 49'$. (*prismé.* H.)—Fig. 492. The primary having both the edges and angles of the base truncated. (*dioctaèdre.* H.)—Fig. 493. P on $u = 152° 8'$. u on $l = 159° 17'$. (*quadrisexdécimal.* H.)—Fig. 494. P on $x = 150° 5'$. l on $x = 142° 55'$. x on $x = 147° 12'$. (*plagièdre.* H.)—Fig. 495. (*binotriunitaire.* H.)

Irregular forms and grains.

Cleavage, parallel with P and *l*, the latter more distinct; but rather perfect. Surface, *t* and *s* rough. The other faces are mostly smooth and shining.

Lustre, more or less perfectly adamantine. Color red, brown, yellow, grey, green, white; excepting some red tints, none of them bright. Streak white. Transparent to translucent.

Hardness = 7·5. Sp. gr. = 4·505.

1. Before the blow-pipe, it loses its color but does not melt.

2. *Analysis.*

By Berzelius.

Silica	33·62		33 30
Zirconia	66.38		66·70

3. Zircon is found in imbedded crystals in mountain masses, or in beds included in them, from whence it is washed into the sand of rivers.

4. It occurs with Epidote in the Saualpe in Carinthia, in sienite at Frederiksvärn in Norway. In Ceylon, in France, at Bilin in Bohemia, at Ohlapian in Transylvania, it occurs in the sand of rivers.

The largest and most perfect crystals afforded by the United States, have been found loose in the soil in Buncombe co. (N. C.) Handsome crystals are found in gneiss at Warwick, and in Magnetic Iron, at Munroe, and in Scapolite at Edenville, (N. Y.) Crystals closely resembling the variety from Norway, were found in loose masses of sienite at Middlebury, (Vt.) Large and handsome brown crystals occur in talcose slate at Easton, (Penn.) Small but very perfect forms are met with at Haddam, (Conn.) with Chrysoberyl, Garnet, &c.

5. Zircon is sometimes used as a gem, but it is not much esteemed.

Zurlite.

ZOISITE. (See *Epidote*.)

ZURLITE.

Form, rectangular four-sided prisms, lengthened in the direction of the axis, and having sometimes their lateral edges replaced.

Cleavage indistinct. Fracture conchoidal. Surface rough, generally covered with a white coating, sometimes convex.

Lustre resinous. Color asparagus-green. Streak pearl-grey. Hardness about 6·0. Sp. gr. =3·274.

1. It is infusible before the blow-pipe, but yields with borax, a bluish glass. Nitric acid dissolves it, partly, with effervescence and assumes a yellow color.

It is found at Somma, with Dolomite.

CHEMICAL ARRANGEMENT OF THE SPECIES.

PRELIMINARY OBSERVATIONS.

The nomenclature adopted in the present Tabular view of the chemical relations of the species, has been taken from an unpublished manuscript, by Mr. J. D. Dana. It resembles in several points that by Berzelius. Its peculiarities, however, are numerous, and hence a brief outline of its rules becomes necessary.

The elements are divided into two classes,—into *Amphigen* and *Oudegen Elements;* the former containing those which are electro-negative in acid and basic compounds, the second those whose mutual combinations produce neither acids nor bases.*

The binary compounds are named as follows: the adjective part of the name is derived from the name of the most electro-positive element, if the two elements of the compound are of the same class: but from the oudegen ele-

* This distinction is natural, each element which is electro-negative in a class of acids, is also electro-negative in a class of bases, with which the acids may unite and form salts. On the contrary, those elements which do not give rise to acids, do not give rise to bases.

ment, if one is from each of the classes. It is formed by the termination *ic* or *ous*. The substantive part of the name is formed by affixing to the other element the termination *acid*, if the compound will unite with bases and form salts, otherwise the syllable *ide*. Thus we have *mercuric chloracid*, (Horn Quicksilver,) and *zincic sulphide*, (Blende.) The different proportions in which any two elements combine, are expressed by the prefixes, *hypo*, *hyper* and *per* in the usual manner. The particle *sur* is prefixed to the substantive in the non-acid compounds of the Amphigen elements, when the electro-negative element exists in too large a proportion to enable them to act the part of bases; and the particle *sub*, when it is in too small a proportion.

Numerals are seldom used, except in the salts. They are prefixed to the substantive part of the name, unless they refer to the whole compound expressed by both adjective and substantive, in which case they are affixed to the adjective. The number of atoms of the substantive element are expressed by the Latin numerals, *bis*, *ter*, *quater*, &c.; that of the adjective element, by the Greek numerals, *dis*, *tris*, &c. Several atoms of both base and acid are expressed by a prefix, formed by combining the Latin and Greek numerals.

The names of the salts are formed as follows: The adjective of the name of the salt is derived from the adjective of the name of the base, and the substantive from the name of the acid, by changing the termination acid into *ate* if the adjective ends in *ic*, but into *ite* if it ends in *ous*, and prefixing to these terminations the initial syllable or syllables of the acidified substance.

For the sake of brevity, the distinguishing prefix *ox* in the oxacids is dropped; consequently the name for Coppe-

ras is the *ferrous sulphate*,—sulphate being a contraction for sulpho-oxate.

The compound salts are named by combining the names of the simple salts.

Whenever a star is prefixed to the chemical name of a species, or of a group of species in the following table, notice is given that the expression is not intended to convey an idea of the atomic constitution of the species or group. In such cases, the ingredients only are indicated.

TABULAR VIEW.

The mineralogical species constitute five Classes; which are variously subdivided into families, orders and genera.

CLASS I.

consists of Elements, and embraces two families, the Amphigen family, and the Oudegen family.*

Amphigen Family.	Oudegen Family.
Oxygen.	Nitrogen.
Sulphur.	Arsenic.
	Carbon, &c.

CLASS II.

embraces Acid compounds of the Amphigen elements, and includes three genera, which are named from the

* The order of succession in the families, orders, genera and species, is the electro-negative, according to the table of Berzelius, the most electro-negative being placed first.

electro-negative element in the compounds. The species derive their names from the electro-positive element of the combination.

GENUS I.	GENUS II.	GENUS III.
OXACID.	CHLORACID.	SULPHACID.
Sp. Sulphurous.	*Sp.* Hydric.	*Sp.* Selenous.
Arsenic,		Hypo-arsenous,
&c.		&c.

CLASS III.

consists of non-acid compounds of Amphigen elements, and contains seven genera, which, together with the species, are named as in Class II.

GENUS I.	GENUS II.	GENUS III.
OXIDE.	FLUORIDE.	CHLORIDE.
Sp. Chromic.	*Sp.* Ceric.	*Sp.* Mercuric.
Antimonic, &c.	Aluminic, &c.	Argentic, &c.

CLASS IV.

contains salts, or those compounds resulting from the union of acids and bases. It consists of two orders, Oxisalt and Sulphisalt. The genera and species are named as in the foregoing classes.

ORDER I. OXISALT.

GEN. I. Sulphate.	GEN. II. Nitrate.
Sp. Cupric.	*Sp.* Magnesic.
Plumbic, &c.	Calcic, &c.

ORDER II. SULPHISALT.

GEN. I. ARSENO-SULPHITE.	GEN. II. ANTIMONO-HYPO-SULPHITE.
Sp. Argentic tris-	*Sp.* Argentic,
	Argentic tris-

CLASS V.

consists of compounds of the Oudegen elements, and forms five genera, which derive their names from the most electro-negative element in the compound.

GEN. I. ARSENIDE.
Sp. Cobaltic.
Nickelic.

GEN. II. CARBONIDE.
Sp. Hydrous.

CLASS I.

AMPHIGEN FAMILY.

Oxygen	*Oxygen.*
Sulphur*	*Native Sulphur.*

OUDEGEN FAMILY.

Nitrogen	*Nitrogen.*
Arsenic	*Native Arsenic.*
Carbon	*Diamond.*
	Anthracite.
	Plumbago.
Antimony	*Native Antimony.*
Hydrogen	*Hydrogen.*
Gold	*Native Gold.*
Platina	*Native Platina.*
Palladium	*Native Palladium.*
Mercury	*Native Mercury.*
Silver	*Native Silver.*
Copper	*Native Copper.*

* The remaining Amphigen Elements in Chemistry are, Fluorine, Chlorine, Bromine, Iodine, Selenium and Tellurium.

Bismuth	*Native Bismuth.*
Lead	*Native Lead.*
Iron	*Native Iron.*

CLASS II.

Genus I. Oxacid.

Sulphurous	*Sulphurous Acid.*
Sulphuric	*Sulphuric Acid.*
Arsenic	*White Arsenic.*
Molybdic	*Molybic-Ochre.*
Tungstic	*Tungstic-Ochre.*
Boric	*Sassolin.*
Carbonic	*Carbonic Acid.*
Antimonic	*White Antimony.*
Titanic	*Rutile.*
	Anatase?
Silicic	*Quartz.*
Hydrated	*Opal.*

Genus II. Chloracid.

Hydric	*Muriatic Acid.*

Genus III. Sulphacid.

Selenous	*Sulphoselenite.*
Hydric	*Sulphuretted Hydrogen.*
Hypo-arsenous	*Realgar.*
Arsenous	*Orpiment.*
Hypo-antimonous	*Grey Antimony.*

CLASS III.

Genus I. Oxide.

Section A. Simple.

Nitric sub-	*Atmospheric Air.*
Chromic	*Chrome-Ochre.*
Antimonic	*Antimony-Ochre.*
Hydric	*Water.*
Cuprous	*Red Copper-Ore.*
Cupric	*Melaconite.*
Uranous	*Pitchblende.*
Bismuthic	*Bismuth-Ochre.*
Stannic	*Tin-Ore.*
Plumbous sur-	*Minium.*
Cobaltic sur-	*Cobalt-Ochre.*
Ferric	*Specular Iron.*
Hydrated	*Limonite.*
Manganous	*Pyrolusite.*
Manganic	*Braunite.*
Hydrated	*Manganite.*
Aluminic	*Corundum.*
Hydrated	*Gibbsite.*
	Diaspore.
Magnesic	
Hydrated	*Native Magnesia.*

Section B. Mixed.

Ferrous & bi-ferric	*Magnetic Iron.*

Manganous & bi-manganic	*Black Manganese.*
*Ferric, ferrous, manganous, bi-manganic & zincic	*Franklinite.*

Genus II. Fluoride.

Section A. Simple.

Ceric	*Fluocerite.*
Aluminic	*Fluellite?*
Calcic	*Fluor.*

Section B. Mixed.

Aluminic & sodic	*Cryolite.*
*Ceric, yttric & calcic	*Yttrocerite.*

Genus III. Chloride.

Mercuric	*Horn Quicksilver.*
Argentic	*Horn Silver.*
Plumbic	*Kerasite.*
Sodic	*Common Salt.*
Ammonic	*Sal-Ammoniac.*

Appendix to Genus III.

(Combination of a chloride with an oxide.)

*Cupric ox. & chloride Hydrated	*Atacamite.*

Genus IV. Iodide.

Argentic	*Iodic Silver.*

Genus V. Sulphide.

Section A. Simple.

Molybdic	*Molybdenite.*
Mercuric	*Cinnabar.*
Argentic	*Vitreous Silver.*
Bismuthic	*Bismuthine.*
Cuprous	*Vitreous Copper.*
Plumbic	*Galena.*
Cobaltic	*Cobalt Pyrites.*
Nickelic	*Capillary Pyrites.*
Per-ferric	*Iron Pyrites.*
	White Iron Pyrites.
Zincic	*Blende.*
Manganic	*Mangan-Blende.*

Section B. Mixed.

Per-ferric & quinqui-ferrous	*Magnetic Iron Pyrites.*
Argentic & cuprous	*Stromeyerite.*
Argentic & ferrous	*Sternbergite.*
Ferrous & bi-cuprous	*Variegated Copper.*
*Copper, tin & iron	*Tin Pyrites.*
* Copper, bismuth & lead	*Cupreous Bismuth.*

Appendix to Genus V.

(Combination of a sulphide with an oxide.)

*Antimonic oxide & sulphide	*Red Antimony.*

Genus VI. Selenide.

Section A. Simple.

Cupric	*Selencuprite.*
Plumbic	*Clausthalite.*

SECTION B. MIXED.

Cuprous & argentic	*Eukairite.*

Genus VII. TELLURIDE.

SECTION A. SIMPLE.

Argentic	*Telluric Silver.*
Bismuthic	*Bornite.*
Plumbic	*Black Tellurium.*

SECTION B. MIXED.

Auric & argentic	*Graphic Gold.*
Mercuric & zincic	*Rionite.*
Bi-auric, argentic & plumbic	*Mullerite.*

CLASS IV. SALTS.

ORDER I. OXISALT.

Genus I. SULPHATE.

SECTION A. SIMPLE.

Cupric	*Brochantite.*
Hydrated	*Blue Vitriol.*
Plumbic	*Anglesite.*
Cobaltic	
Hydrated	*Cobalt Vitriol.*
Ferrous	
Hydrated	*Copperas.*
Ferric	
Hydrated	*White Copperas.*
Zincic	*White Vitriol.*

Aluminic Hydrated	*Solfatarite.*
Aluminic tri-Hydrated	*Websterite.*
Magnesic Hydrated	*Epsom Salt.*
Calcic	*Anhydrite.*
Hydrated	*Gypsum.*
Strontic	*Celestine.*
Baric	*Heavy Spar.*
Sodic	*Thénardite.*
Hydrated	*Glauberite.*
Potassic	*Aphthitalite.*

SECTION B. MIXED.

Cupric & uranic Hydrated	*Johannite.*
*Ferric & magnesic Hydrated	*Botryogene.*
Ter-aluminic & potassic Hydrated	*Alum.*
Calcic & sodic	*Glauberite.*
*Calcic, potassic & magnesic Hydrated	*Polyhallite.*

APPENDIX TO GENUS I.

(Combination of a sulphate and an oxide.)

*Plumbic sulphate & cupric oxide	*Cupreous Anglesite.*

Genus II. Nitrate.

Magnesic Hydrated	*Nitro-Magnesite.*
Calcic	*Nitrocalcite.*
Sodic	*Soda Nitre.*
Potassic	*Nitre.*

Genus III. Phosphate.

Section A. Simple.

Cupric Hydrated	*Pseudo-Malachite.*
Ferrous Hydrated	*Vivianite.*
Aluminic Hydrated	*Wavellite.*
Yttric	*Xenotime.*
Calcic	*Apatite.*

Section B. Mixed.

*Uranic & cupric, (or calcic) Hydrated	*Uranite.*
Ferrous & manganous	*Triplite.*
*Aluminic & magnesic	*Blue Spar.*
	Lazulite.
Aluminic ter- & lithic	*Amblygonite.*

Appendix to Genus III.

(Combination of a phosphate and a chloride.)

*Magnesic phosphate & chloride	*Wagnerite.*
Ter-plumbic phosphate & plumbic chloride	*Pyromorphite.*

Genus IV. Arsenate.

Cupric	*Olivenite.*
*Hydrated	*Erinite.*
	Copper Mica.
	Aphanesite.
	Euchroite.
Cobaltic	
Hydrated	*Cobalt Bloom.*
Nickelic	
Hydrated	*Nickel Green.*
Ferric	
Hydrated	*Cube Ore.*
	Skorodite.
Calcic	
Hydrated	*Pharmacolite.*
	Haidingerite.

Appendix to Genus IV.

(Combination of a phosphate with an arsenate.)

*Calcic phosphate & plumbic arsenate	*Hedyphane.*

Genus V. Chromate.

Section A. Simple.

Plumbic	*Red Lead Ore.*

Section B. Mixed.

*Cupric & plumbic	*Vauquelinite.*

Genus VI. Molybdate.

Plumbic	*Yellow Lead Ore.*

Genus VII. Tungstate.

Section A. Simple.

Plumbic	*Scheeletine.*
Calcic	*Tungsten.*

Section B. Mixed.

*Ferrous & manganous	*Wolfram.*

Genus VIII. Borate.

Magnesic	*Boracite.*
Sodic	
Hydrated	*Borax.*

Genus IX. Carbonate.

Section A. Simple.

Cupric di-	
Hydrated	*Green Malachite.*
Cupric tri-bi-	
Hydrated	*Blue Malachite.*
Uranic	*Uran-Bloom.*
Plumbic	*White Lead Ore.*
Ferrous	*Spathic Iron.*
Zincic	*Calamine.*
Manganic	*Diallogite.*
Calcic	*Calcareous Spar.*
	Arragonite.
Strontic	*Strontianite.*
Baric	*Witherite.*
Sodic	
Hydrated	*Natron.*
	Trona.

SECTION B. MIXED.

*Ferrous & magnesic	*Rhomb Spar.*
Magnesic & calcic	*Dolomite.*
	Ankerite.
Baric & calcic	*Baryto-Calcite.*
Calcic & sodic Hydrated	*Gay Lussite.*

APPENDIX TO GENUS IX.

(Combination of a carbonate and a chloride.)

Plumbic	*Corneous Lead.*

(Combination of a carbonate and a telluride.)

*Nickelic	*Herrerite.*

(Combination of a carbonate and a sulphate.)

Plumbic	*Lead Hillite.*
	Dyoxilite.
*Plumbic & cupric carbonate & cupric sulphate	*Caledonite.*

(Combination of a carbonate and an arsenate.)

*Cupric arsenate & calcic carbonate *Kupaphrite.*

Genus X. COLUMBATE.

*Ferrous & manganous (sometimes stannic)	*Columbite.*
*Yttric & ceric	*Fergusonite.*
*Yttric & calcic (or uranic)	*Yttro-tantalite.*

Genus XI. TITANATE.

SECTION A. SIMPLE.

Calcic	*Pyrochlore.*

Section B. Mixed.

*Ferrous & ferric (also manganous)	*Crichtonite.*
Ceric & zirconic	*Aischynite.*
*Ferrous, zirconic & yttric	*Polymignite.*

Genus XII. Silicate.

Section A. Simple.

Cupric	
Hydrated	*Chrysocolla.*
	Dioptase.
Manganous	*Red Manganese.*
Ceric	
Hydrated	*Cerite.*
Zirconic	*Zircon.*
Aluminic-di.	*Kyanite.*
*Hydrated	*Gmelinite.*
	Allophane.
Glucinic bi-	*Phenakite.*
*Magnesic	
Hydrated	*Pyrallolite.*
	Picrosmine.
	Picrolite.
	Talc.
	Serpentine.
	Kerolite.
Magnesic bi-	*Boltonite.*
Calcic	*Gismondin.*
Calcic bi-	*Tabular Spar.*

SECTION B. MIXED.

(Double.)

*Ferrous & manganous	*Troostite.*
*Ferric & aluminic	*Helvin.*
	Staurotide.
*Ferrous & magnesic	*Bronzite.*
	Peridot.
*Ferrous & calcic	*Yenite.*
*Ferric & sodic	*Achmite.*
*Aluminic & manganous	*Karpholite.*
*Aluminic & zirconic	*Bucholzite.*
*Aluminic & calcic	*Scapolite.*
*Hydrated	*Prehnite.*
	Mesotype.
	Brewsterite.
	Heulandite.
	Thomsonite.
	Edingtonite.
	Epistilbite.
	Stilbite.
	Laumonite.
	Levyne.
	Chabasie.
*Aluminic & glucinic	*Beryl.*
	Euclase.
*Aluminic & magnesic	*Nephrite.*
	Iolite.

*Aluminic & baric	
Hydrated	*Harmotome.*
*Aluminic & lithic	*Petalite.*
	Spodumene.
*Aluminic & sodic	*Albite.*
	Pitchstone.
Hydrated	*Analcime.*
*Aluminic & potassic	*Leucite.*
	Feldspar.
	Periklin.
	Andalusite.
	Nepheline.
	Figure-stone.
*Calcic & potassic	
Hydrated	*Apophyllite.*

(Ternary.)

*Ferrous, manganous & sodic	*Cummingtonite.*
*Thoric, ferrous & manganous	*Thorite.*
*Zirconic, calcic & sodic	*Eudyalite.*
*Yttric, cerous & ferrous	*Gadolinite.*
*Aluminic, ferrous & manganous	*Schiller Spar.*
*Aluminic, magnesic & ferrous	*Fahlunite.*
*Aluminic, calcic & ferrous	*Epidote.*
	Idocrase.
*Aluminic, calcic & sodic	*Labradorite.*
*Aluminic, calcic & potassic	*Pyroxene.*

(Quaternary.)

*Ferrous, aluminic, sodic & calcic	*Saussurite.*
*Aluminic, calcic, ferrous & ceric	*Allanite.*
*Aluminic, potassic, ferrous & lithic	*Mica.*
*Magnesic, calcic, aluminic & ferrous (or manganous)	*Hornblende.*
*Calcic, aluminic, ferrous & manganous	*Garnet.*
	Axinite.

Appendix to Genus XII.

(Combination of a silicate with a fluoride.)

*Aluminic silicate & fluoride	*Topaz.*
*Magnesic silicate & fluoride	*Brucite.*

(Combination of a silicate with a chloride.)

*Ferrous & manganous silicate & ferric chloride	*Pyrosmalite.*

(Combination of a silicate with a borate)

*Aluminic, ferrous (or manganous) & potassic (or sodic, lithic or magnesic)	*Tourmaline.*

(Combination of a silicate with a carbonate.)

*Bismuthic	*Bismuth Blende.*

(Combination of a silicate with a titanate.)

*Calcic	*Sphene.*

Genus XIII. Manganite.

Cupric	*Cupreous Manganese.*
*Zincic	*Red Zinc-Ore.*
Baric	*Psilomelane.*

Genus XIV. Alluminate.

Section A. Simple.

Plumbic	*Plumbo-Gummite.*

Section B. Mixed.

*Chromic & ferrous	*Chrome-Ore.*
*Zincic & magnesic	*Automalite.*
*Glucinic & ferrous	*Chrysoberyl.*

Genus XV. Mellate.

Aluminic	*Mellite.*

ORDER II. SULPHISALT.

Genus I. Arseno-Sulphite.

Section A. Simple.

Argentic tris-	*Proustite.*

Section B. Mixed.

*Cuprous & ferric	*Tennantite.*

Genus II. Antimono-Hypo-sulphite.

Section A. Simple.

Argentic	*Myargyrite.*

Argentic tris-	*Red Silver.*
Argentic hex-	*Black Silver.*
Plumbic bis-	*Zinkenite.*

SECTION B. MIXED.

*Cuprous & plumbic	*Bournonite.*
*Cuprous, zincic & ferrous	*Fahlerz.*

APPENDIX TO GENUS II.

(Combination of an antimono-hypo-sulphite with an arseno-sulphite.)

Cuprous arseno-sulphite & argentic antimono-hypo-sulphite	*Polybasite.*

Genus III. ANTIMONO-SULPHITE.

Plumbic di-ter-	*Jamesonite.*

CLASS V.

Genus I. ARSENIDE.

Cobaltic	*Cobaltine.*
Nickelic	*Copper Nickel.*
*Ferric	*Leucopyrite.*

APPENDIX TO GENUS I.

(Combination of an arsenide with a sulphide.)

Ferric	*Mispickel.*

Genus II. CARBONIDE.

*Hydrous	*Carburetted Hydrogen.*
	Bituminous Coal.
	Bitumen.

Genus III. Antimonide.

*Argentic	*Antimonial Silver.*

Appendix to Genus III.

(Combination of an antimonide with a sulphide.)

Nickelic	*Nickel Glance.*

Genus IV. Osmide.

Iridic	*Irid-osmium.*

Genus V. Mercuride.

Argentic	*Native Amalgam.*

APPENDIX.

ALBITE.

Very distinct crystals of this species are found at Williamstown, (Mass.,) where it is associated with Dolomite ?. Some of the crystals are three quarters of an inch in diameter, and highly transparent. They are pretty constantly twin-crystals, and very much modified. A similar variety is also found at Middletown, occupying druses in a coarse grained granite, consisting chiefly of Feldspar. The crystals at the last mentioned place are invariably compound.

ALLANITE. (See Vol. I. p. 6.)

The variety from Iglorsoit in Greenland, has a sp. gr. = 3·449. Before the blow-pipe, it swells up on first feeling the heat, but on continuing the heat, it melts into a black and very brittle vitreous pearl, which, while it is hot, exhibits a honey yellow color, and becomes greenish yellow when cold. The mineral gelatinizes in nitric, as well as in muriatic acid. According to STROMEYER, it contains

Silica	33·021
Alumina	15·226
Protoxide of cerium	21·600
Protoxide of iron	15·101
Protoxide of manganese	0·404
Lime	11·080
Water	3·000

ALUMOCALCITE.

Massive. Color milk-white, inclining to blue. Fracture conchoidal. Small fragments may be rubbed to pieces between the fingers. Sp. gr. = 2·174. Adheres strongly to the tongue.

It yields water in the glass tube, and becomes opake and grey colored when exposed to heat in the platina forceps. With borax, it forms a colorless glass. It is soluble in salt of phosphorus, with the exception of a silica-skeleton. In concentrated muriatic acid, it forms a transparent jelly. KERSTEN found it to consist of

Silica	86·60
Lime	6·25
Alumina	2·23
Water	4·00

It is found in the fissures of iron-stone veins at Eybenstock in the Erzgebirge. It was formerly confounded with Opal.

ANALCIME.

In large crystals in trap, at Keweena Point, Lake Superior.

ANTHOPHYLLITE. (See Vol. I. p. 26.)

Its angles are precisely the same as those of Hornblende, with which species it is identical in other properties.

APATITE.

This species is found in crystals above an inch in length, and smaller, as well as massive, at Middletown, (Conn.), in granite. Its colors are bluish green, greyish and pinkish white. It is associated with Columbite, Uranite and Albite.

ARFWEDSONITE. (See Vol. I. p. 38.)

Analysis.

By THOMSON.

Silica	50·50
Peroxide of iron	35·14
Deutoxide of manganese	8·92
Alumina	2·49
Lime	1·56
Water	0·96

ARRAGONITE.

Very beautiful massive varieties of this mineral, abound at Ball's Cave, Schoharie, (N.Y.) It forms stalactites and stalagmites of a snowy whiteness.

ARSENICAL SILVER.

Mammillary, or consisting of very thin crystalline coats. Fracture uneven. Color resembling Native Silver, but tarnished externally. Lustre metallic, shining or glimmering. Sectile. Brittle. Streak shining.

Before the blow-pipe, it emits a strong arsenical odor, and a globule of pure silver remains, surrounded by a slag. It consists, according to KLAPROTH, of

Silver	12·75
Arsenic	35·00
Iron	44·25
Antimony	4·00

It occurs at Andreasberg in the Hartz, in Estremadura in Spain, and at Kongsberg in Norway.

ARSENIURET OF MANGANESE.

Botryoidal. Massive. Composition granular. Fracture uneven. Color greyish-white. Sp. gr. = 5·55.

1. In the air it becomes coated by a black powder. Before the blow-pipe, it burns with a blue flame, attended by a white smoke, and the odor of garlic. It is soluble in nitric acid.

2. *Analysis.*

By KANE.

Manganese	45·50
Arsenic	51·80
Oxide of iron	2·70

3. It is found in Saxony.

BERZELINE.

In extremely minute white crystals. Lustre vitreous. Feebly translucent. It is fusible with difficulty into a pale glass, and gelatinizes with heated acids. It appears to be anhydrous.

Its locality is Galloro, near La Ricia in the Roman states, where it is accompanied by black crystals of Garnet and pinchbeck Mica, in the drusy cavities of an augite-rock.

BIOTINE.

Fracture vitreous to conchoidal. Lustre brilliant. Color white or yellowish. Transparent. Presents double refraction. Hardness, scratches glass. Sp. gr. = 3·11.

It is not affected by the blow-pipe, and is only partly soluble in nitric acid.

It is found among the volcanic debris of Vesuvius.

BLACK TELLURIUM. (See Vol. I. p. 68.)

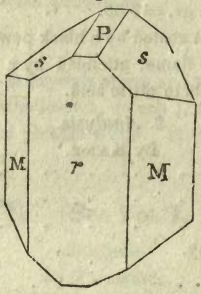
Analysis, by BERTHIER, of a variety from Nagyag. Sp. gr. = 6·84.

Gold	6·70
Tellurium	13 00
Lead	63·10
Antimony	4·50
Copper	1·00
Sulphur	11·70

BOTRYOGENE. (See Vol. I. p. 82.)

Secondary form.

Fig. 497.



M on M	119° 56′
s on *s*	141 00

The above figure does not perfectly represent the crystals of Botryogene, inasmuch as face *r* does not exist, and the acute lateral edges are bevelled, the bevelling faces meeting under 81° 44′. The lateral planes striated vertically, and less perfectly formed, than the terminal planes.

BUCKLANDITE. Dystome Augite-Spar. HAIDINGER. (See Vol. I. p. 93.)

Sp. gr. = 3·945. ROSE; brilliant crystals in the lava of Lacher-See.

1. It is completely soluble in muriatic acid.

CARBONATE OF CERIUM.

In thin, four sided crystalline plates of a greyish-white color, and in coatings on Cerite. It does not change its appearance, though it loses

19 p. c. of its weight when exposed to a slight red heat. It occurs in very small quantity at Bastnaes in Sweden.

Carbonate of Lime and Soda.

Massive. Cleavage like Calcareous Spar. Transparent. Possesses double refraction. Before the blow-pipe it decrepitates a little, becomes brown, and is eventually reduced to lime. It is entirely soluble with effervescence in nitric acid. It contains

Carbonate of lime - - - - - -	70·00
Carbonate of soda - - - - - -	14 00
Water - - - - - -	9·7
Peroxide of iron - - - - - -	1·0

Its locality is not known.

CELESTINE.

Analysis.

By Daurier.

Sulphate of strontian	68·900
Sulphate of lime	0·105
Carbonate of lime	27·785
Oxide of iron	0·150
Oxide of manganese	0·050
Water	3·000

Chonikrite.

Massive: composition impalpable. Fracture uneven, and imperfectly conchoidal. Lustre glimmering, or dull. Color white, with shades of yellow and grey. Translucent, often only on the edges. Scratches Common Salt; is scratched by Fluor.

1. It melts before the blow-pipe easily, into a greyish glass. With borax, it slowly melts into a glass colored by iron. It is easily decomposed by concentrated muriatic acid.

2. *Analysis.*

By Kobell.

Silica	35·69
Alumina	17·12
Magnesia	22 50
Lime	12·00
Protoxide of iron	1·46
Water	9·00

3. It occurs in rounded masses at Elba,

CHROME ORE.

Analysis.

By ABICH.

Alumina	11·85
Protoxide of chrome	60·04
Magnesia	7·45
Protoxide of iron	20·13

CHRYSOCOLLA.

It appears to be abundant at Keweena Point, Lake Superior, in connexion with the trap and sandstone formation.

COBALTIC GALENA.

In minute moss-like groups of crystals, and massive. Cleavable. Lustre metallic. Color lead-grey, inclining to blue. Opake. Soils a little.

When heated before the blow-pipe, it splits into fragments, and communicates a smalt-blue color to borax.

Analysis.

By DU MENIL.

Lead	62·89
Arsenic	22·47
Sulphur	0·47
Iron	2·11
Cobalt	0·94
Arsenical pyrites	1·44

It occurs in a vein of clay-slate, in one of the Clausthal mines in the Hartz.

COBALT PYRITES. Cobaltic Eruthleucone-Pyrites.

Primary form. Regular octahedron?

Massive; composition granular ... impalpable. Individuals indistinctly cleavable. Fracture conchoidal, uneven.

Lustre metallic. Color pale steel-grey, rarely presenting a reddish tinge.

Hardness = 5·0 ... 6·0.

1. Heated before the blow-pipe, it decrepitates briskly. Upon charcoal, it emits the odor of sulphurous acid, and melts into a magnetic globule, which is steel-grey on the surface, and bronze-yellow within.

2. *Analysis.*

	By Wernekinck.	By Hisinger.
Sulphur	42·25	38·50
Cobalt	53·35	43·20
Iron	2·30	3·53
Copper	0·97	14·40

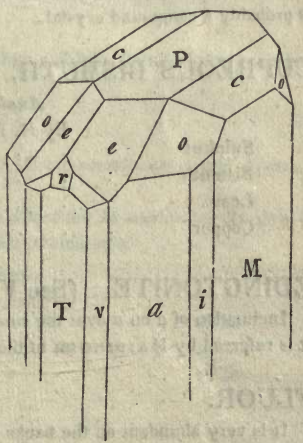
3. It is found in beds, at Riddarhyttan in Sweden, in gneiss.

COLUMBITE.

A very interesting deposit of this species has lately been discovered at Middletown, (Conn.) It exists in granite. The crystals are occasionally distinguished for their regularity and high degree of lustre, and are very generally of unusual dimensions for the species. One of these in the possession of Mr. F. Merrick, the discoverer of the locality, weighs three or four ounces. Several of the angles of the annexed figure were obtained by means of the reflective goniometer.

Fig. 498.

T on *v*	- -	157° 40′
T on *a*	- -	129 30
T on *i*	- -	112 10??
v on *a*	- -	150 10
a on *i*	- -	162 30?
M on *a*	- -	140 40
M on *v*	- -	107 45?
P on *c*	- -	160 23
M on *c*	- -	109 37
c on *o*	- -	140 30
a on *o*	- -	144 00
M on *o*	- -	128 30
e on *e*	- -	149 30
a on *e*	- -	126 30
P on *e*	- -	137 20?
P on *o*	- -	127 00

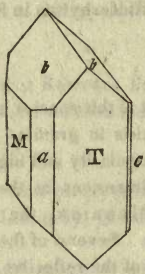


Associated with the crystals of Columbite are Apatite, Uranite and Albite.

COPPER PYRITES. (See *Yellow Copper Pyrites*, Vol. II. p. 283.)

CUPREOUS ANGLESITE. (See Vol. I. p. 159.)

Fig. 499.



M on T - - 95° 45′ | *b* on *b* - - 119°

Cleavage, very perfect parallel to M; less so parallel to *c*. Fig. 155 is probably a compound crystal.

CUPREOUS BISMUTH. (See Vol. I. p. 160.)

Analysis.

By H. FRICK.

Sulphur	16·61
Bismuth	36·45
Lead	36·05
Copper	10·59

EDINGTONITE. (See Vol. I. p. 178.)

Inclination of *a* on *a* over the summit = 129° 8′; of *b* to *b* = 92° 41′. It is referred by HAIDINGER to the genus Feldspar.

FLUOR.

It is very abundant on the banks of the Muscolonge lake, in the town of Alexandria, Jefferson co. (N.Y.) It occurs with Calcareous Spar in cavities in gneiss. It is limpid and colorless, or slightly tinged with green, and in cubical crystals of very great size, sometimes above a foot in diameter.

Forsterite. (See Vol. I. p. 214.)

Its cleavage, perpendicular to the axis, is very distinct. Hardness = about 7·0.

Fowlerite. (See *Manganese Spar.*)

Gansekothig-Erz.

Mammillary. Color yellow or pale green. Lustre resinous. Fracture conchoidal. Translucent. Shining, with a white streak. Hardness = 2·0 . . . 3·0.

Before the blow-pipe, it emits copious fumes of arsenic, and fuses into a blackish scoria; when the heat is continued on charcoal, the scoria melts, and yields a button of silver, but the slag contains metallic iron, which strongly affects the magnet. It is supposed to be an arseniate of silver and iron.

It occurs mostly in the mines of Clausthal in the Hartz, where it is of some importance as an ore of silver. It is likewise met with in Cornwall, and at Allemont in Dauphiny.

Gigantolite.

A mineral composed of alumina, lime and iron, found in the granitic rocks of Taméla in Finland.

Green Vitriol.

Massive, granular. Lustre dull. Color sometimes a fine green, more often of a greyish green.

1. It dissolves readily, and without alteration, in muriatic acid; slowly in ammonia, and rapidly in carbonate of ammonia.

2. *Analysis.*

By Berthier.

Deutoxide of copper	66·20
Sulphuric acid	16·60
Water	17·40

3. It is found in Mexico.

Humboldtilite.

In right square prisms. Lustre vitreous. Semi-transparent. Fracture uneven. Color yellow, or yellowish grey. Hardness = 5·00. Sp. gr. = 3·104.

1. It fuses easily before the blow-pipe into a spongy, shining and transparent glass; with acids it forms a jelly.

2. *Analysis.*

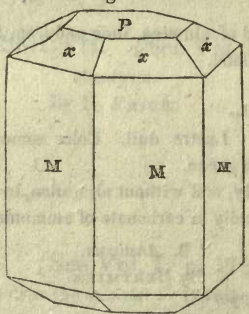
	By Monticelli & Covelli.	By Kobell.
Silica	54·16	43·96
Lime	31·67	31·96
Magnesia	8·83	6·10
Alumina	0·50	11·20
Oxide of iron	2·00	2·32
Soda	0·00	4·28
Potash	0·00	0·38

3. It occurs among the ejected minerals of Mount Vesuvius.

Hydroboracite. Hess. (See *Neues Jahrbuch für Min. Geog. Geol. u. Petre. von.* Leonhard u. Bronn, 1834. p. 353.)

IRIDOSMINE. (See Vol. I, p. 281.)

Fig. 500.



P on z - - - - - 118°

Sp. gr. =19·38 ... 19·47.

The crystals are shorter than in the annexed figure. Color tin white. Hardness =7·0. Undergoes no change before the blow-pipe, and emits no odor. They are found in the gold-sands of Newransk 95 wersts from Catharineburg, and in many other places in the Ural.

Crystals from Nischne Tagil have the same form, but a lead-grey color and a Sp. gr. =21·118. Before the blow-pipe their surface becomes dull, turns black and gives out the smell of osmium.

ISOPYRE. Isopyric Quartz. HAIDINGER. (See Vol. I, p. 287.)

It forms compact masses occasionally two inches in diameter in the granite of St. Just near Penzance, where it occurs associated with Tin Ore and Tourmaline. The *Tachylite* is found in basalt and wacke, at Säsebühl near Göttingen.

KUPAPHRITE. (See Vol. I, p. 295.)

It is found at the mines of Cohonas do Campo in Brazil, associated with Quartz and Magnetic Iron Pyrites.

LAUMONITE.

It is found in considerable quantity at Keweena Point, Lake Superior, in amygdaloid. Its color is reddish white, sometimes nearly brick-red, and its structure coarse granular. It is mingled with Calcareous Spar, and appears to be less prone to decomposition than the white varieties.

LEADHILLITE. (See Vol. II, p. 6.)

The primary form of this species according to HAIDINGER and BREWSTER is prismatic, instead of rhombohedral. The left hand *e* fig. 275, inclines to the central *e* under 120° 20′, and the central *e* to that on the right hand under 119° 50′; *a* on the left hand *e* =90° 29′.

NATRON.* (See Vol. II, p. 77.)

It is often observed within the crater of Vesuvius sublimated among the crevices of hot lava. It is common also on the walls of old mines and cellars. The most abundant deposit is the soda-lakes of Egypt; it likewise occurs in the hot springs of Carlsbad in Bohemia and Rykum in Iceland.

ONKOSIN.

Massive: composition impalpable. Fracture splintery to imperfectly conchoidal. Color light apple-green, to greyish and brownish. Lustre vitreous to resinous. Translucent. Hardness between 2·0 and 3·0. Sp. gr. =2·80.

1. Before the blow-pipe, swells up and easily melts into a white, blebby, vitreous and somewhat translucent glass. With borax, it gradually forms a transparent and colorless glass.

2. *Analysis.*

By KOBELL.

Silica	52·52
Alumina	30 88
Magnesia	3·82
Protoxide of iron	0·80
Potash	6·38
Water	4·60

3. It occurs in small roundish masses in Dolomite at Possegen near Tamsweg in Salzburg. It closely resembles Figure-Stone.

PHILLIPSITE. Staurotypous Kouphone-Spar. HAIDINGER.

Crystalline form, scarcely different from that of Harmotome.

Lustre, color, transparency and hardness also identical with those of the same species.

Sp. gr. =2·0...2·2.

1. *Analysis.*

By GMELIN.

	from Marburg.
Silica	48·02
Alumina	22·61
Potash	7·50
Lime	6·56
Water	16·75

2. It occurs in large translucent crystals in the cavities of amygdaloid at the Giant's Causeway in Ireland; forming groups of sheaf-shape aggregations at Capo di Bove near Rome; at Aci Reale, on the eastern coast of Sicily, Marburg in Hessia, Lowenstein in Silesia and among the Lavas of Vesuvius. The specimens from Aci Reale present elongated crystals, which adhere closely together, and radiate from a centre in globular concretions. It has also been found with Gmelinite in the island of Magee, Antrim county, in minute flesh-red colored crystals, coating cavities of amygdaloid.

PURPLE COPPER-ORE. (See *Variegated Copper.*)

Pyrosklerite.

Massive. Cleavage parallel with the faces of a rhombic prism. Fracture uneven and splintery. Lustre on the cleavage faces feebly pearly, in other directions it is dull. Color, apple-green to light greenish grey. Hardness between 2·5 and 3·5. Sp. gr. = 2·74. Streak white.

1. Before the blow-pipe it fuses with difficulty into a greyish glass. With borax, it slowly yields a glass colored by chrome. It is decomposed, when in the state of powder by concentrated sulphuric acid.

2. *Analysis.*

By Kobell.

Silica	37·03
Alumina	13·50
Magnesia	31·62
Protoxide of iron	3·52
Green oxide of chrome	1·43
Water	11·00

3. It occurs at Elba with Chonikrite. It seems to be closely related to Picrolite.

Raphyllile. (See *Hornblende.*)

Retinalite. (See *Serpentine.*)

RHOMB SPAR. (See Vol. II, p. 164.)

Analysis.

By Stromeyer.

Magnesia	41·06		42·40
Protoxide of iron	8·57		7·47
Oxide of manganese	0·43		0·62
Carbonic acid	48·94		49·67

SASSOLIN. (See Vol. II, p. 171.)

The deposit of this mineral occurs within the crater of Volcano, one of the Lipari Islands, where it forms thin coatings on the surface of sulphur, and around the openings, whence the subterranean exhalations are discharged. The variety deposited by the lagunes of Tuscany and the hot-springs of Sasso is of a greyer color, and harder than that from Volcano. According to Klaproth, it contains 11 p. c. of sulphate of magnesia, and 3 p. c. of sulphate of lime.

For economical purposes, it is obtained at Pomorance in Tuscany, by causing the volcanic vapors which arise in that vicinity to pass through water, and then evaporating the impregnated fluid in leaden vessels.

Silicate of Cerium.

In regular hexagonal prisms. Cleavage parallel to the axis of the prism. Color pale, yellowish brown. Translucent.

It is found with Emerald in Dolomite at Santa Fé de Bogota in Peru.

SODA-NITRE. (See Vol. II, p. 186.)

This salt is employed in the manufacture of nitric acid and salt-petre.

Steinmannite.

Primary form. Cube. Secondary form. Regular octahedron.

Cleavage parallel to the cube imperfect and scarcely visible. Fracture uneven. Surface of the crystals smooth. Lustre metallic. Color pure lead-grey. Hardness = 2·5. Sp. gr. = 6·833. *Compound Varieties.* Botryoidal. Massive, composition fine granular. In some varieties a curved lamellar composition is visible. Composition also compact, sometimes porous.

1. When heated before the blow-pipe, on charcoal, it decrepitates with violence. Its powder heated, emits the odor of sulphurous acid, and a metallic globule remains as in the case of Galena, but which finally yields a distinct button of silver. It appears to consist of lead, antimony, silver and sulphur.

2. It is found at Przibram with Quartz, Blende and Iron Pyrites.

Titaniferous Cerite.

Color blackish brown. Lustre vitreous. Fracture conchoidal. Hardness equal to that of Gadolinite. When heated it swells up; it is acted upon both by acids and alkalies.

Analysis.

By Laugier.

Oxide of cerium	36·00
Oxide of iron	19·00
Lime	8·00
Alumina	6·00
Water	11·00
Oxide of manganese	1·80
Silica	19·00
Oxide of titanium	8·00

It is found on the Coromandel coast.

URAN-BLOOM.

In small crystalline flakes. Color bright yellow, between lemon-yellow and sulphur-yellow. Opake with little lustre.

1. When slightly heated before the blow-pipe, its color becomes orange-yellow. It is soluble with effervescence in acid, yielding a yellow solution, which affords a brown precipitate with prussiate of potash, thus proving it to be a carbonate of uranium.

2. It occurs in silver veins at Joachimsthal in Bohemia, with Pitchblende and Pharmacolite.

URANITE.

It is found in small quantity in thin yellow scales at Middletown, (Conn.) where it exists in granite associated with Columbite, Apatite and Albite.

VANADIATE OF LEAD.

There appears to be no reason for separating this mineral from Pyromorphite. It is imperfectly crystallized in hexagonal prisms, and botryoidal, as well as in thin coatings. Color straw-yellow to reddish-brown. Opake and dull. Before the blow-pipe, in a pair of forceps, it fuses, and on cooling retains its yellow color; if kept for some time in fusion, however, it is changed into a steel-grey porous mass, which upon charcoal, yield immediately globules of lead. Alone, on charcoal, it fuses readily, exhales the odor of arsenic, is reduced, and leaves, after heating in the inner flame, a steel-grey, very fusible slag, which exhibits the reactions of chromium. It forms green solutions with the sulphuric and muriatic acids, and a beautiful yellow solution with nitric acid. The variety from Mexico, according to BERZELIUS, consists of

Chloride of lead	25·33
Vanadiate of lead	74·00
Hydrous ox. iron	0·67.

It occurs at Wanlockhead in Dumfriesshire, sprinkled over Calamine.

END OF THE SECOND VOLUME.

REESE LIBRARY OF THE UNIVERSITY OF CALIFORNIA

U. C. BERKELEY LIBRARIES
C053178864
Storage